# Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LVI. MARCH, 1919. No. 3

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MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. Fox, President; J. H. Pritchard, Secretary.

The Editorial and Advertising Offices are at 538 S. Clark St., CHICAGO, ILLINOIS. Samuel C. Hadden, Editor.

Single copies, 25 cents. The yearly subscription price in the United States and its Possessions, Cuba and Mexico, is $2.00; in Canada, $2.40; and in all other countries, $2.75.

Entered as second-class matter July 1, 1899, at the Post Office at Indianapolis, Indiana, under the Act of March 3, 1879.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should be addressed to 538 S. Clark St., Chicago, Illinois.

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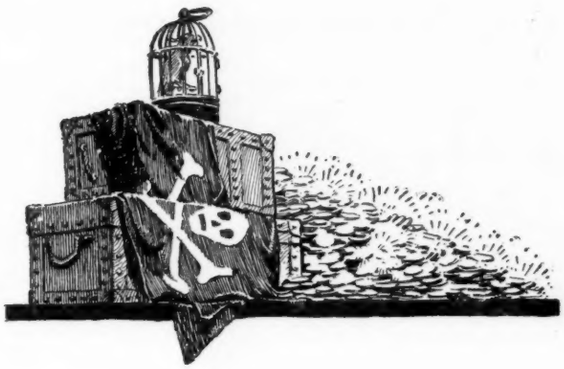

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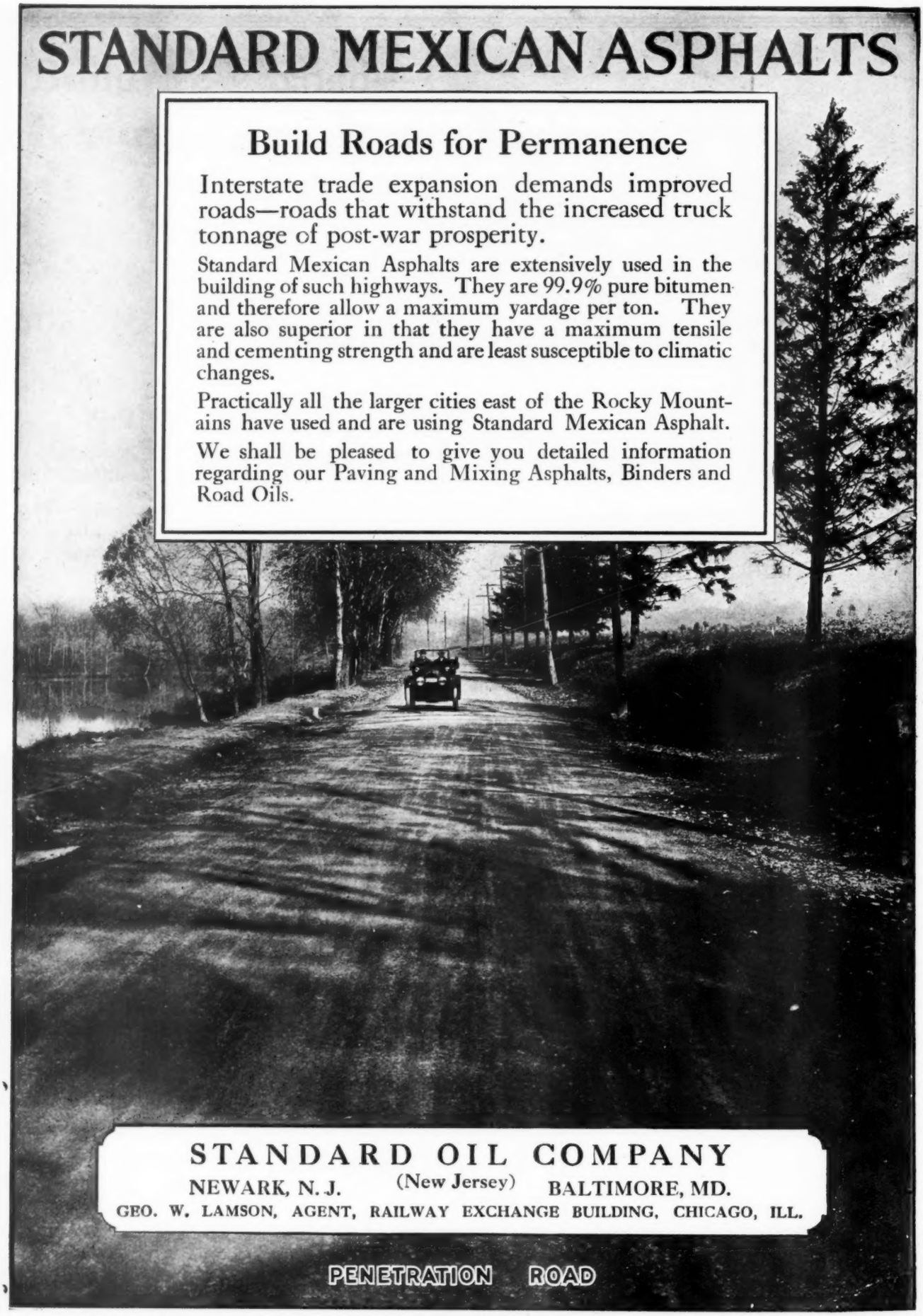

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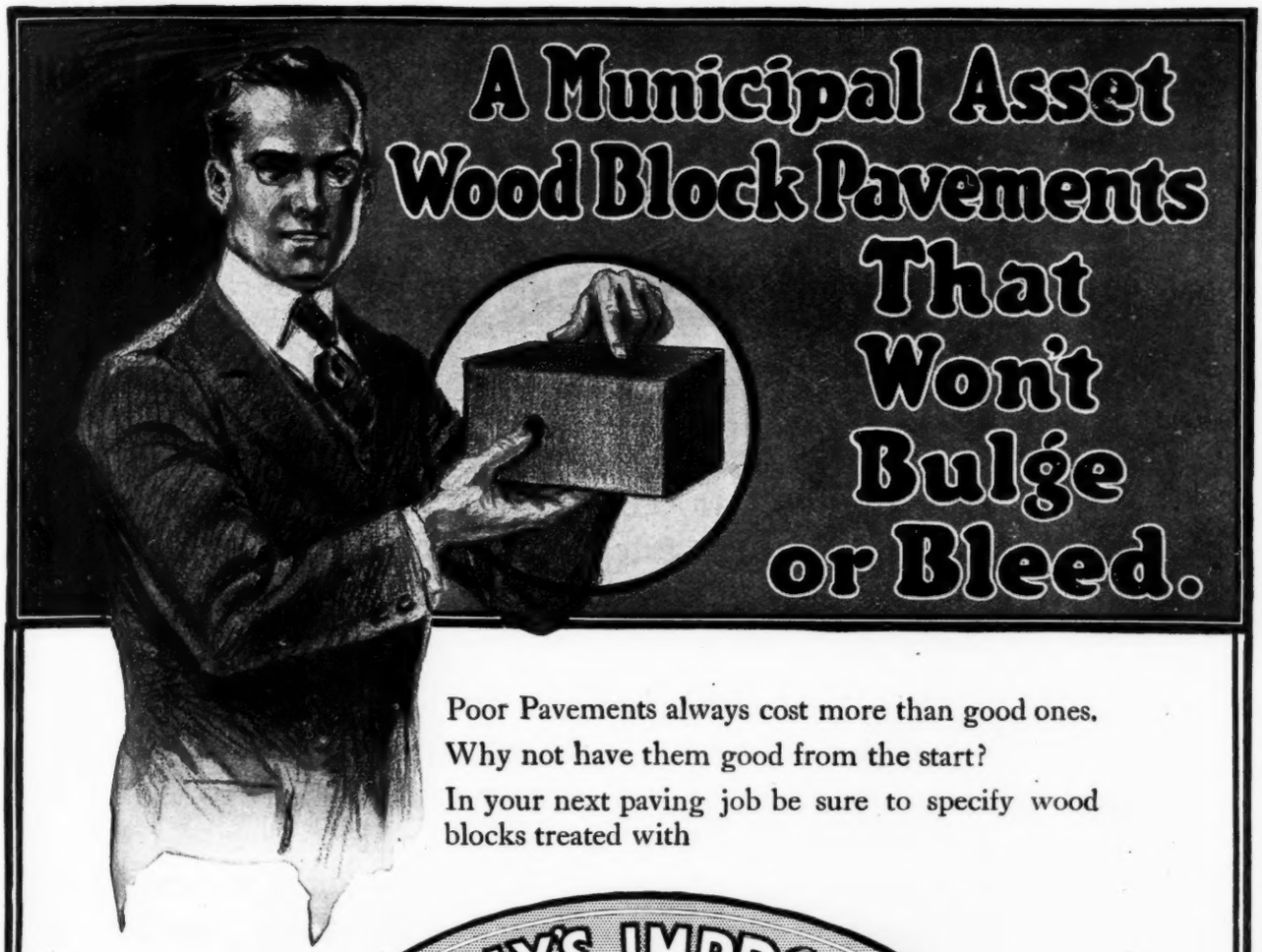

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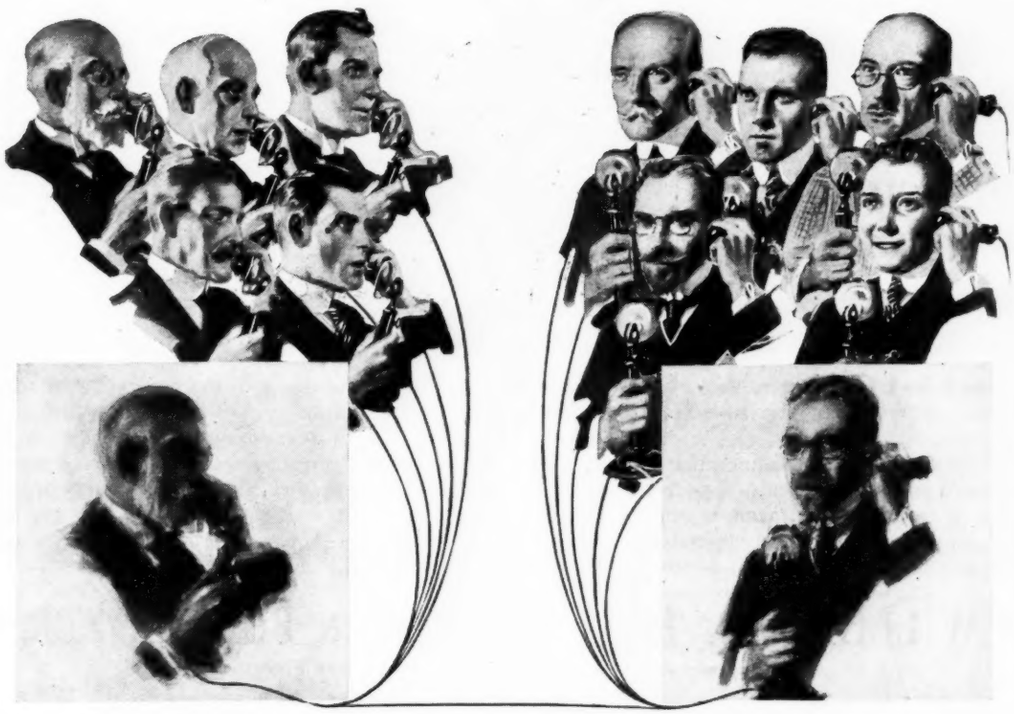

# Multiplexing the Telephone

Marvel has followed marvel since Alexander Graham Bell invented his first simple telephone, the forerunner of the millions in use today.

In these last four decades thousands of Bell engineers have developed a system of telephonic communication, so highly perfected, that the same crude instrument which at the beginning could hardly carry speech from one room to another can now actually be heard across the continent. This is because of the many inventions and discoveries which have been applied to intervening switchboard, circuits and other transmitting mechanism.

The vision of the engineers has foreseen requirements for increased communication, and step by step the structure of the art has been advanced—each advance utilizing all previous accomplishments.

No one step in advance, since the original invention, is of greater importance, perhaps, than that which has provided the multiplex system by which five telephone conversations are carried on today simultaneously over one toll line circuit or, by which forty telegraphic messages can be sent over the one pair of wires. As in a composite photograph the pictures are combined, so the several voice waves mingle on the circuit to be again separated for their various destinations.

By this wonderful development the Bell System obtains for the public a multiplied usefulness from its long distance plant and can more speedily and completely meet the needs of a nation of telephone users.

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*One Policy* *One System* *Universal Service*

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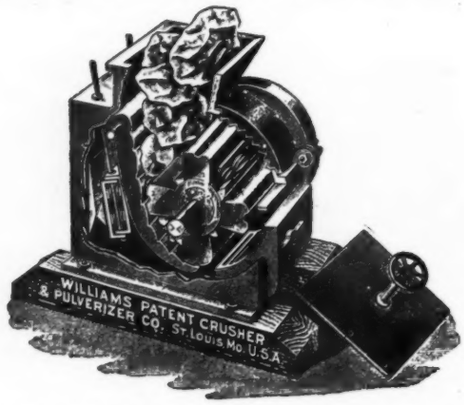
For Contractors




For Road Builders

The **Williams 2-in-1 Crusher** as shown above is admirably suited for the needs of the contractor or road builder. It will take cubes of stone ranging from 5x10 to 16x30 ins., depending on the size of the crusher, and in one operation reduce them to 2, 1½, 1, ¾-in., or even ¼-in. or finer, if desired. In crushing the stone this 2-in-1 Crusher prepares it in about the same manner that hand-broken stone is prepared, making a clean break and not fracturing the sized cubes to any great extent. The result is that stone crushed with the 2-in-1 gives much better service. These machines are built in capacities ranging from 1½ ton per hour to as high as 40 to 50 tons per hour when crushing to 2-in. and under. They operate at a slow speed, use little power, are adjustable almost instantaneously for different sized work, and are built good and substantial. Bulletin No. 0213 gives additional information.

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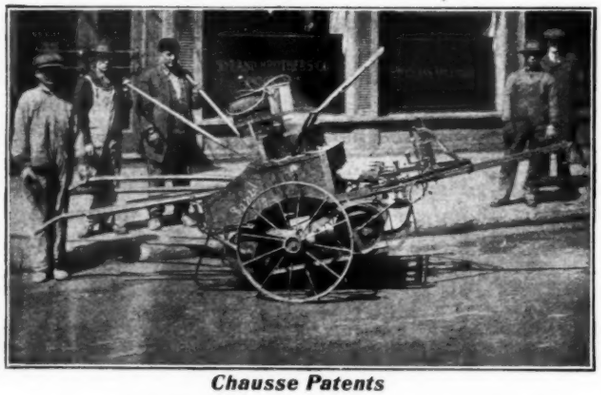

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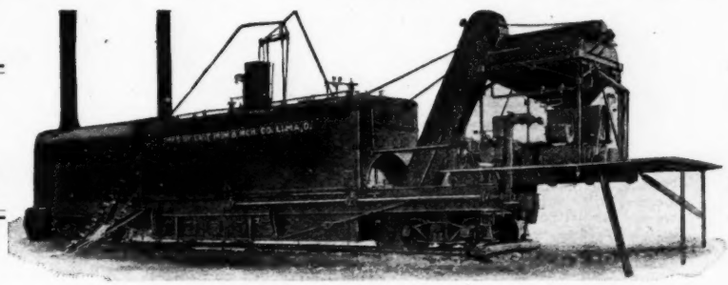

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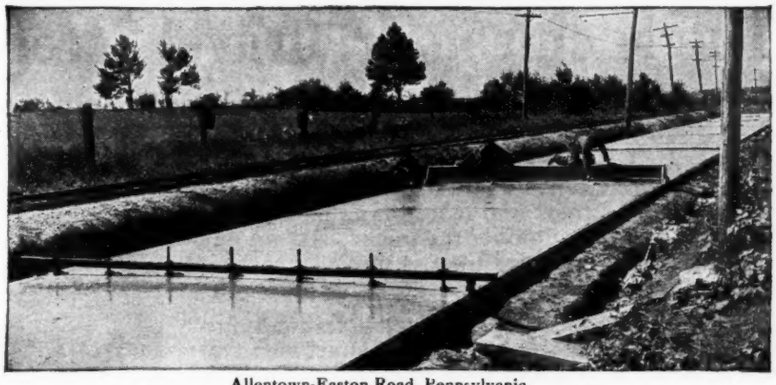

Allentown-Easton Road, Pennsylvania.
W. D. Uhler, Chief Engineer, Pennsylvania State Highway Dept.

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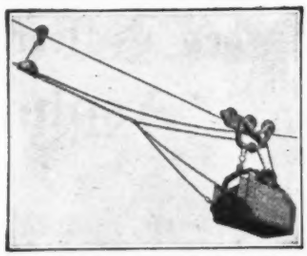

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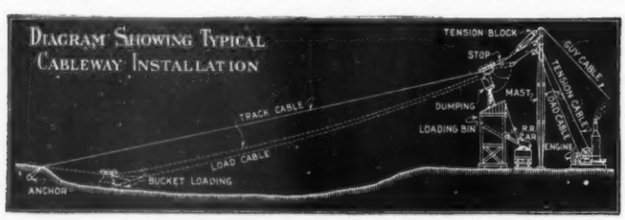

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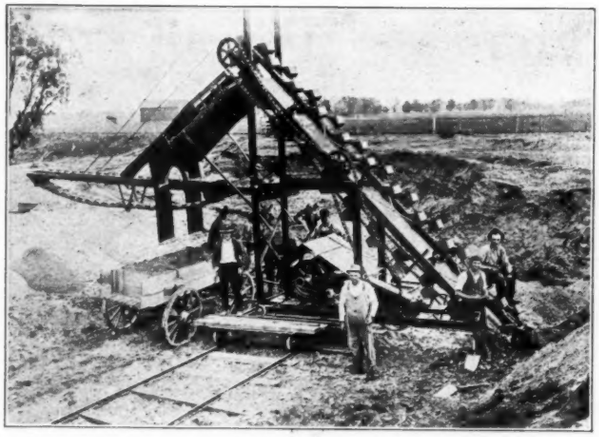

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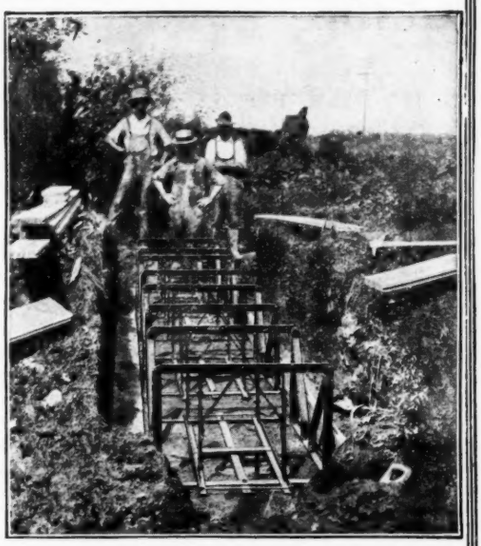

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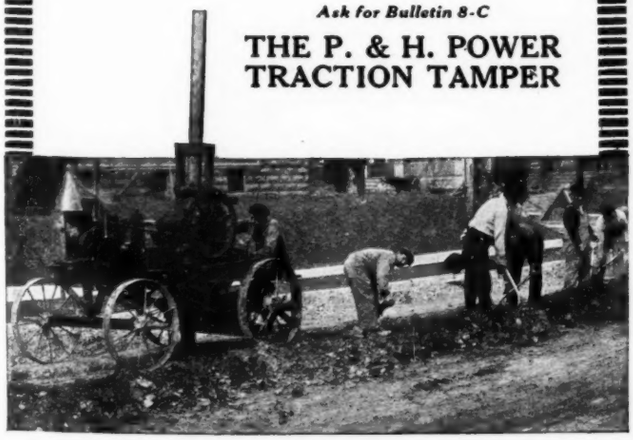

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Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
City Wastes Disposal Co.
Dow & Smith
Garland, C. M.
Samuel A. Greeley
Howard, J. W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander
Sherman, The W. J. Co.
Shields, W. S.
Stillman & Van Siclen
Van Trump, Isaac.

**Contractors.**
City Wastes Disposal Co.
Sullivan, Long & Hagerty
Warren Bros. Co.

**Contractors' Tools and Machinery.**
Alger Supply Co.
Austin-Western Co., Ltd., The
Holzbog & Bro., Geo. H.
Littleford Bros.

**Contractors' Wagons.**
Austin-Western Co., Ltd., The
Holzbog & Bro., Geo. H.

**Conveying Machinery.**
Pawling & Harnischfeger.
Portable Machinery Co., Inc.

**Cranes and Hoists.**
F. C. Austin Co., Inc.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

**Creosote.**
The Barrett Co.
Republic Creosoting Co.

**Creosoted Wood Block.**
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

**Crushers, Rock and Ore.**
Austin-Western Road Machinery Co., The
Beach Mfg. Co.

**Crushed Stone.**
Cleveland Stone Co., The

**Culvert Molds.**
Austin-Western Co., Ltd., The
Storms Mfg. Co.

**Culvert Pipe, Cast Iron.**
American Cast Iron Pipe Co.
Beach Mfg. Co.
Warren Foundry & Machine Co.

**Culvert Pipe, Vitrified.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., Wm. E.
Vitrified Pipe Mfrs. Assn.

**Culverts.**
Beach Mfg. Co.
De Smet Quartz Tile Co.
Truscon Steel Co.

**Curb and Gutter Forms.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Curb Bar.**
Truscon Steel Co.

**Curbing, Sandstone.**
Cleveland Stone Co., The

**Direct Oxidation Process.**
Direct Oxidation Process Corp.

**Drag-Line Excavators.**
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Pawling and Harnischfeger.

**Drag Scrapers.**
Austin-Western Road Machinery Co.

**Drain Tile.**
Dee Clay Mfg. Co., W. E.

**Dryers.**
Cummer & Son Co., The F. D.

**Dump Cars.**
Austin-Western Road Machinery Co., The

**Dump Carts.**
Holzbog & Bro., Geo. H.

**Dump Wagons.**
Austin-Western Road Machinery Co., The
Beach Mfg. Co.
Holzbog & Bro., Geo. H.

**Dust Laying Compound.**
The Barrett Co.
Standard Oil Co. (Indiana)

**Dynamite.**
E. I. DuPont DeNemours & Co.

**Edge Protector.**
Truscon Steel Co.

**Elevating Graders.**
Austin-Western Road Machinery Co.

**Engines.**
Wisconsin Motor Mfg. Co.

**Engineering Instruments.**
Kolesch & Co.
Lufkin Rule Co., The

**Excavating Machinery.**
F. C. Austin Co., Inc.
Buckeye Traction Ditcher Co.
Koehring Machine Co.
Pawling and Harnischfeger.

**Expansion Joint Compound.**
The Barrett Co.
Truscon Steel Co.

**Explosives.**
E. I. DuPont DeNemours & Co.

**Fillers (Paving Joint).**
The Barrett Co.

**Fire Brick.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

**Flue Liners.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis

**Forms, Sidewalks, Curb & Gutter.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

**Forms, Road.**
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

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Heltzel Steel Form & Iron Co.

**Forms (Wall Bldg., Construction, Etc.).**
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Warren Foundry & Machine Co.

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**Gas Pipe.**
American Cast Iron Pipe Co.

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Koehring Machine Co.

**Graders, Turbine.**
Koehring Machine Co.

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Littleford Bros.

**Heating Wagons (Oil and Tar).**
Littleford Bros.

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**Hoists, Electric.**
Pawling and Harnischfeger.

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F. C. Austin Co., Inc.
Koehring Machine Co.

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Dee Co., Wm. E.
Madison Foundry Co.

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The Barrett Co.

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Dee Co., Wm. E.

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# STEWART SEWER CLEANING MACHINE

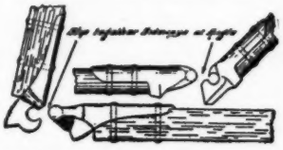
Water Cleaning System if you wish it,
or Drag Bucket type.

**Also have TURBINE SEWER CLEANING MACHINE at Low Price.**

WE WILL PAY FREIGHT AND CHARGE TO BILL.

**We Ship Rods for Trial—who else will do this?**

**We also make a Rod that will float. Also Rods with wheels for conduit work.**



## SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings—Rods retain full size and strength

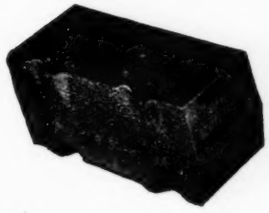
**Investigate our JUMBO ROD**

## W. H. STEWART

1614 Locust Street - - ST. LOUIS, MO.
129 George Street - - - BOSTON, MASS.

CANADA FACTORY, WALKERVILLE, ONT.
THEREFORE NO DUTY FOR PURCHASER TO PAY
PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.

# Springfield Wire-Cut Lug



## IS WIDELY USED

The square edges *stay* square, due to the spacing lugs and beveled ends. Both Dunn Wire-Cut Lug and Frost Process. Sewer and Building Brick—also very artistic Rug Face Brick.

## Springfield Paving Brick Co.

SPRINGFIELD, ILLINOIS

# THE CUMMER ROAD ASPHALT PLANT

THREE SIZES THREE UNITS

**Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily**

# THE CUMMER ONE-CAR ASPHALT PLANT

**Capacity 2000 Square Yards 2-inch Top or Macadam Daily**

## THE F. D. CUMMER & SON COMPANY, Cleveland, Ohio

**Plants in Stock** **Can Show Them in Operation**

# MOVE MATERIALS QUICKLY

WITH THE

SCOOP CONVEYOR

More coal, coke, sand, gravel and similar materials can be loaded, unloaded, stored or reclaimed by one man and the **Scoop Conveyor** than by six to twelve men with ordinary methods. For boxes, bags, crates and bulky packages as well. Keeps other equipment moving. Over 1 000 in use.

**Write for illustrated literature.**

Portable Machinery Co., Inc., Passaic, N. J.

# DIRECT OXIDATION PROCESS

Apparatus for carrying out this Process for Sewage and Water Treatment supplied upon Engineers' specifications.

## Direct Oxidation Process Corporation

15th and Lehigh Ave. Philadelphia, Pa.

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**Mixers, Asphalt.**
F. C. Austin Co., Inc.
Cummer & Sons Co., The F. D.
Koehring Machine Co.

**Mixers, Concrete.**
F. C. Austin Co., Inc.
Koehring Machine Co.

**Molds (Pipe & Culvert).**
Heltzel Steel Form & Iron Co.

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Wisconsin Motor Mfg. Co.

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General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
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Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
J. C. Wilson Co.

**Motor Trucks.**
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Duplex Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
J. C. Wilson Co.

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Federal Motor Truck Co.
Garford Motor Truck Co., The
General Motors Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Pierce-Arrow Motor Car Co.
G. A. Schacht Motor Truck Co.
Service Motor Truck Co.
J. C. Wilson Co.

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Dee Co., Wm. E.

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Barrett Co., The
Truscon Steel Co.

**Paving Blocks (Creosoted).**
The Barrett Co.
Republic Creosoting Co.

**Paving Brick.**
Medal Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

**Paving Contractors.**
Warren Bros. Co.

**Paving Joint Compound.**
The Barrett Co.
Truscon Steel Co.

**Paving Joint Filler.**
The Barrett Co.

**Paving Machines.**
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Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

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Cummer & Son Co., The F. D.
East Iron & Machine Co.
Koehring Machine Co.
Warren Bros. Co.

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Pioneer Asphalt Co.

**Pipe Manufacturers.**
American Cast Iron Pipe Co.

**Pitch Filler.**
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**Plows (Rooter and Wing).**
Austin-Western Road Mach. Co.

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Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Warren Bros. Co.

**Portable Stone Bins.**
Austin-Western Road Machinery Co.

**Powder.**
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**Pumps (Contractors).**
Holzbog & Bro., Geo. H.

**Reinforcing For Pavements.**
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**Road Binder.**
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Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
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Truscon Steel Co.

**Road Graders.**
Austin-Western Road Machinery Co., The
Baker Mfg. Co.

**Road Machinery.**
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Austin-Western Road Machinery Co., The
Baker Mfg. Co.
Beach Mfg. Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Koehring Machine Co.
Owensboro Ditcher and Grader Company
Warren Bros. Co.

**Road Planer.**
Austin-Western Road Machinery Co.

**Road Oils and Preservatives.**
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DuPont Chemical Co.
Standard Oil Co. (Indiana)

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Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.

**Rock Crushers.**
Austin-Western Road Machinery Co., The
Williams Patent Crusher & Pulverizer Co.

**Rock and Sand Heaters.**
East Iron & Machine Co., The

**Roof Coating.**
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Barber Asphalt Paving Co.
The Barrett Co.
DuPont Chemical Co.
Warren Bros.

**Sand Dryers.**
Cummer & Son Co., The F. D.

**Sandstone.**
Cleveland Stone Co.

**Sanitary Carts.**
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**Scarifiers.**
Austin-Western Road Machinery Co., The

**Scrapers, Drag Line.**
Pawling and Harnischfeger.

**Scrapers, Graders, Plows, Etc.**
Austin-Western Road Machinery Co.

**Scrapers, Power.**
Sauerman Bros.

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Holzbog & Bro., Geo. H.

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Electrolytic Sanitation Co.
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**Sewer Castings.**
Dee Co., Wm. E.
Madison Foundry Co.

**Sewer Cleaning Machinery.**
Stewart, W. H.

**Sewer Forms.**
Heltzel Steel Form & Iron Co.

**Sewer Pipe.**
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.
McNutt, Lewis
Vitrified Pipe Mfrs. Assn.

**Sewer Rods.**
Stewart, W. H.

**Sidewalks (Stone).**
Cleveland Stone Co.

**Sluice Gates.**
Coldwell-Wilcox Co.

**Snow Removal Machinery.**
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Austin-Western Road Machinery Co., The

**Steel Joists, Studs and Sash.**
Truscon Steel Co.

**Steel Tapes.**
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Lufkin Rule Co., The

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Austin-Western Road Machinery Co.
Williams Patent Crusher & Pulverizer Co.

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**Stone Elevators.**
Austin-Western Road Machinery Co.

**Stone Flagging.**
Cleveland Stone Co.

**Stone Spreaders.**
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Burch Plow Works Co.
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**Stone Screens.**
Austin-Western Road Machinery Co.

**Street Cleaners' Carts.**
Holzbog & Bro., Geo. H.

**Street Cleaning Machinery (Horse Drawn).**
Austin-Western Road Machinery Co., The

**Street Crossings.**
Cleveland Stone Co.

**Street Flushers (Horse Drawn).**
Austin-Western Road Machinery Co.

**Street Paving Material.**
Barber Asphalt Paving Co.

**Street Sprinklers (Horse Drawn).**
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Lewis-Hall Iron Works.

**Surveyors' Instruments.**
Kolesch & Co.
Lufkin Rule Co., The

**Sweepers.**
F. C. Austin Co., Inc.
Austin-Western Road Machinery Co., The
Elgin Sales Corp.

**Tamping Machines.**
Pawling and Harnischfeger.

**Tanks, Water Supply.**
Mensch, L. J.

**Tar and Pitch.**
The Barrett Co.
DuPont Chemical Co.

**Tar Heaters.**
Alger Supply Co.
Littleford Bros.

**Tarvia.**
The Barrett Co.

**Testing Chemists.**
Dow & Smith
Howard, J. W.
Kirschbraun, Lester
Van Trump, Isaac.

**Traction Engines.**
Austin-Western Road Machinery Co., The

**Traction Engines (Oil or Kerosene).**
Austin-Western Road Mach. Co.

**Tractors.**
F. C. Austin Co., Inc.

**Trailers.**
Warner Mfg. Co.

**Trench Braces.**
Kalamazoo Fdy. & Mach. Co.

**Trench Machinery.**
F. C. Austin Co., Inc.
Buckeye Traction Ditcher Co.
Holzbog & Bro., Geo. H.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

**Valves.**
Coldwell-Wilcox Co.

**Wall Coping.**
Cannelton Sewer Pipe Co.

**Warrenite.**
Warren Bros. Co.

**Water Pipe.**
American Cast Iron Pipe Co.
Warren Foundry & Machine Co.

**Waterproofing.**
Barber Asphalt Paving Co.
Barrett Co., The
Truscon Steel Co.

**Water Purification.**
Direct Oxidation Process Corp.
Electric Ozone Sterilizer Co. of America.
Electrolytic Sanitation Co.
Pennsylvania Salt Mfg. Co.
Wallace & Tiernan Co., Inc.

**Water Works Supplies and Equipment.**
American Cast Iron Pipe Co.
Alger Supply Co.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

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Austin-Western Road Machinery Co.

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Truscon Steel Co.

**Wire-Cut Lug Brick.**
Medal Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

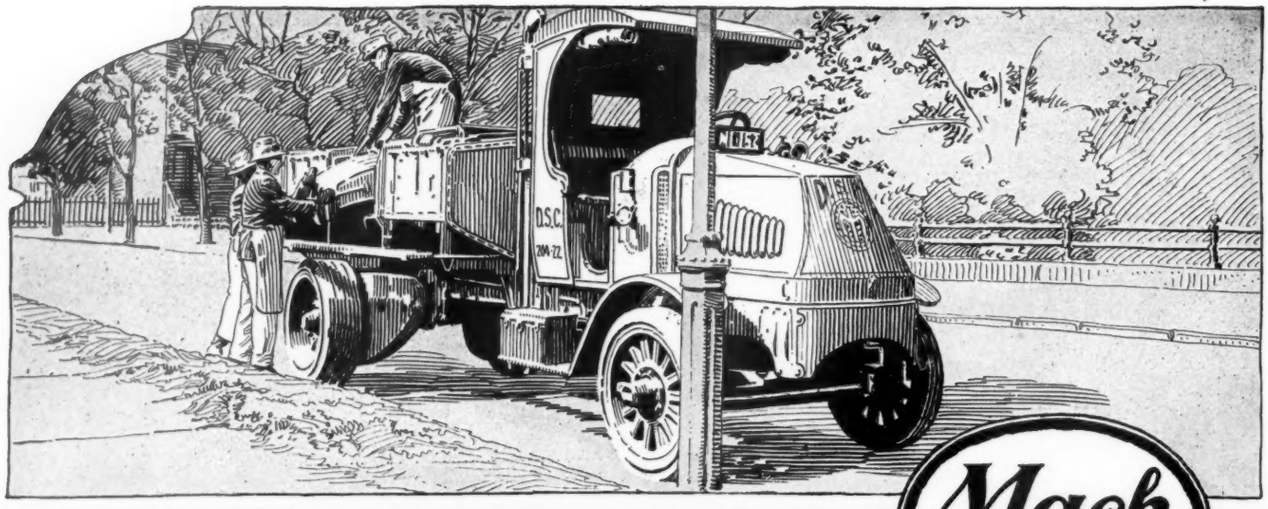
**Wood Block (Creosoted).**
Barrett Co., The
Republic Creosoting Co.

**Wood Preservatives.**
Barrett Co., The
DuPont Chemical Co.
Republic Creosoting Co.

# MOTOR TRUCKS

PIERCE-ARROW 5-TON TRUCK AS OPERATED BY C. BOWEN & CO., BOSTON, MASS., IN HOISTING 6-TON SAFE WITH MEAD-MORRISON VERTICAL WINCH.

Printed as insert to Municipal and County Engineering, March, 1919.



Mack TRUCKS

## All Year Utility

All-year utility is represented in the MACK double service municipal equipment shown herewith.

New York City's Street Cleaning Department has a large fleet of MACK trucks, with chasses convertible for two distinct and opposite tasks.

For summer service tanks with flusher and sprinkler attachments are installed. In winter time when watering the streets makes traffic hazardous, these same chasses are converted into automatic dump trucks, with steel inclosed sanitary garbage and ash collecting bodies.

Formerly it was necessary to lay up flushers and sprinklers during the winter months, representing a considerable loss on the truck investment. New York City and other cities of equal progressiveness can capitalize on their investments by purchasing MACK trucks with all their favorable features for the interchange of body equipment and the attachment of special municipal adjuncts.

MACK trucks in sizes 1—7½ tons. Tractors, 5—7—11—15 tons.

**INTERNATIONAL MOTOR COMPANY**
**NEW YORK**

*"Performance Counts"*

Mack TRUCKS

**A Five Million Dollar Company with a definite system of Service is back of every Garford Truck.**

*"Users Know"*

**The Garford Motor Truck Company, Lima, Ohio**
**Motor Trucks of all Capacities**
***Distributors and Service Stations in all principal cities***

# MOTOR TRUCK OPERATION AND ACCOUNTING XLIII

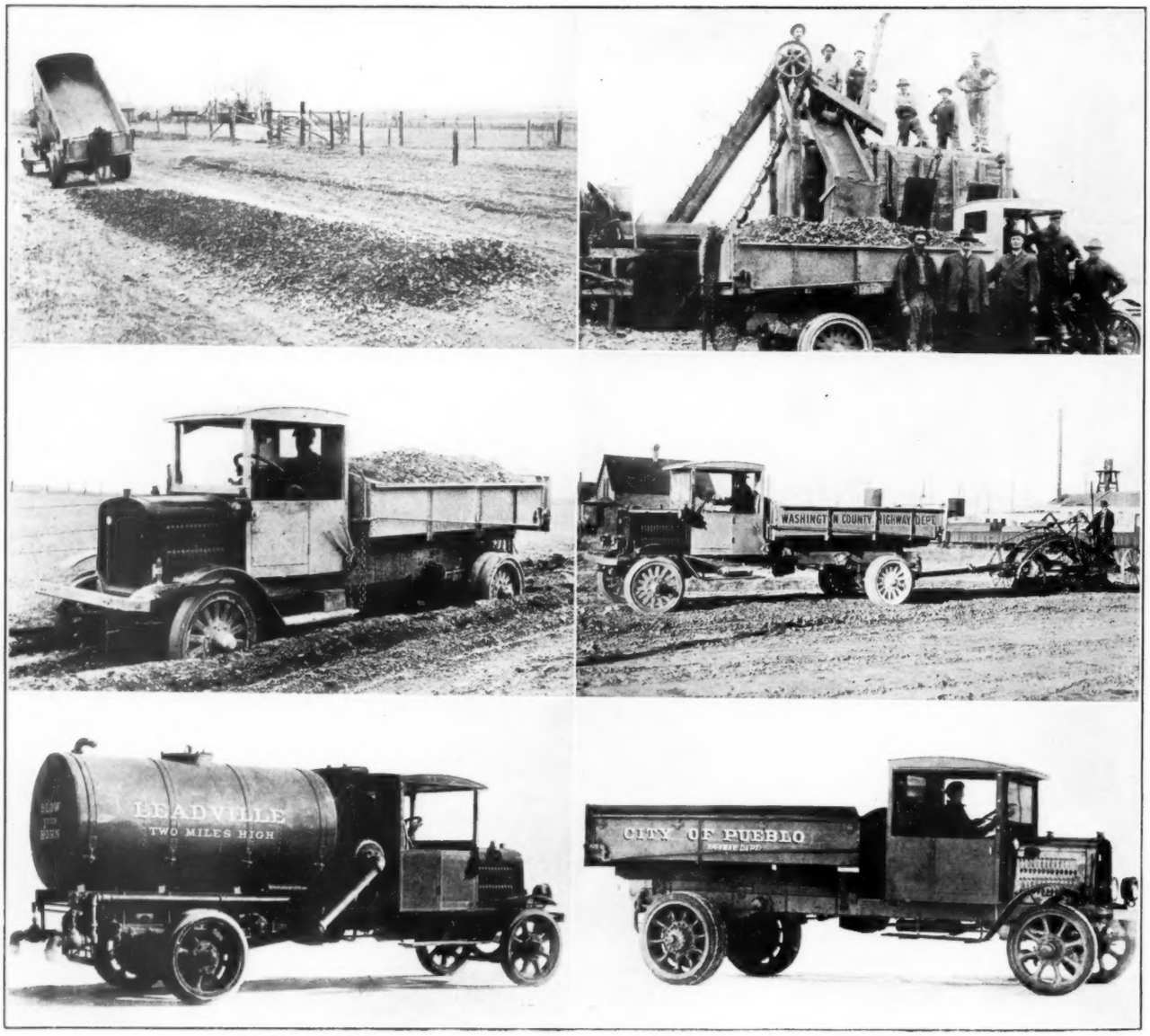
Prominent state, county and municipal officials continue to give the most convincing sort of endorsements of the worth of motor trucks on the construction and maintenance of public works. At the recent Road Congress in Chicago, for example, Paul D. Sargent, Chief Engineer, State Highway Commission of Maine, gave some very interesting facts and figures relative to the performance of motor trucks on road maintenance work in Maine. His data and discussion follow.

*1-Ton Truck Replaces From 2 to 4 Horses*

During the season of 1918 we have had four 1-ton trucks in road maintenance patrol service. These trucks have replaced from two to four horses under the old scheme. In other words, we have combined two, three or four patrol sections and have employed a truck driver with two to three helpers. The longest section under such patrol arrangement was 33 miles of bituminous macadam. We have had several sections of tar surface treated gravel cared for by the truck patrol. Our observation is that these sections of road have been better cared for than in any previous season and we plan to operate the trucks another year. The trucks are not heavy enough, however, to draw a drag and when it has been necessary to drag the shoulders we have had to employ teams.

*Cost Comparison*

A comparison of the cost of patrol maintenance by trucks and by horses is interestng. On one of our State highways, 55 miles in length, in the season of 1917 we employed four




KISSEL TRUCKS AS OPERATED IN MUNICIPAL AND COUNTY SERVICE.

Top Row: Kissel Road Builder's Truck Spreading its Load of Crushed Stone near Boulder, Colo.—Road Building Crew and Equipment, Boulder, Colo. Center Row: Heavy Duty Road Builder Living up to its Name—Heavy Duty Truck Drawing 8 Ft. Austin Road Grader. Bottom Row: 1,000 Gal. Sprinkler on Kissel 5-Ton Chassis, Leadville, Colo.—Kissel 5-Ton Truck as Operated by Highway Department at Pueblo, Colo.

*The Seal of Dependable Performance*

ACME THE TRUCK OF PROVED UNITS

*Trade Mark Registered U. S. Patent Office*

# The Truck That Never Failed

## An Interesting Story of an Acme in the Fire Swept District of Northern Minnesota

No better illustration of why **Acme** enjoys repeat sales of 100 per cent is to be found than in the following letter written by the Secretary and General Manager of the Western Crucible Steel Casting Co., Minneapolis, to a prospective purchaser. Read this letter and get a new slant on truck performance.

"September 14, 1917, we purchased, through the Brehm-McMullen Company of this city, one 2-ton Acme truck. This car has been in actual service since September 14, 1917, to date, having been in that time, out of service in all, six days at intervals; this time being lost in cleaning out carbon and grinding in valves. All the repair bills and other upkeep bills from September 14, 1917, to date, have been $20.10.

"In May, 1918, we purchased a 1-ton Acme truck, and so far have not spent one cent for repairs. When the call came for trucks to handle supplies in the fire devastated districts of northern Minnesota, we sent this 1-ton truck and driver with the State Militia. This car was in actual service for ten days, running night and day. No truck was ever put to a more severe test than this one. This car averaged from 50 to 75 miles a day, over roads that seemed impassable, and came home just as good as when it left.

"I tell you the above so that you can see why we like the Acme truck, as so far it has never failed us. We are about to contract for another 3-ton Acme, as our business demands it. You will make no mistake when you place your order for an Acme Truck."

No wonder engineers bank on **Acme.** Under the severest stress and strain which a truck in construction work must undergo, the **Acme** has always proved more than capable to perform any task it has been called upon to do. Engineers everywhere endorse the **Acme** and stick to it.

**Acme Proved Units**

**The *Why* of Acme success. Every unit standardized by the greatest engineers of the industry.**

Continental Red Seal Motor
Timken Axles
Timken Bearings
Timken-Detroit Worm Drive
Heat-treated pressed steel frame
Borg & Beck Clutch
Ross Steering Gear
Cotta Transmission
Blood Bros. Universal Joints
Detroit Springs
Artillery Type Wheels
Eisemann High Tension Magneto
Rayfield Carburetor
Stewart Vacuum Feed
Tubular Truck Type Radiator
Centrifugal Type Governor

**Acme Motor Truck Co.**

**426 Mitchell St. Cadillac, Michigan**

ACME

REG. U.S. PAT. OFF.

*The Truck of Proved Units*

**Built in 1 to 5 ton models—oversize in capacity and dimensions. Bodies built in our own factories.**

Write for our booklet

**"Pointers to Profits"**

Which gives some interesting facts regarding Acme.

Let us send details regarding special Acme bodies to suit the particular needs of a truck in engineering and construction service.

patrolmen, each with one horse and with more or less extra help. The total cost for horse and man labor in patrolling this 55 miles of road during the season was $10,711.77. During the season of 1918 we substituted two 1-ton trucks. The cost of labor, including operating expenses of the two trucks and an allowance of $2 per day for each truck as a depreciation charge, figures $8,098.01. This shows a saving of about $2,500 in the maintenance of this 55 miles of road, and the road has been much better taken care of than previously.

"Figures on another section of State highway 34 miles in length are as follows: In 1917 the total cost for labor and horses for the entire season was $4,392.38. During 1918 the same road was maintained with one truck and three men at a cost of $2,704.76, including the depreciation and maintenance of the truck. This shows a saving of almost $1,700 on this section of road.

"On one other section, 20 miles in length, where in 1917 we had two patrolmen, each with a horse, our expense for the year, including extra help, was $3,599.65. This year the same section has been maintained with one truck and two men besides the foreman and the total expense for truck and labor has been $3,806.17. This is the only section which shows an increase over the cost of maintaining with horses. It is fair to state that in this section was a piece of road 1.7 miles long which was not quite finished as to construction in the fall of 1917. The patrol gang in 1918 finished the surface of this road, which needed considerable patching, dragging, regravelling. The condition of this road, as already indicated with respect to the other sections, is far above its general condition in 1917.

"It will be seen from these statements that our experience with trucks for maintenance has been very satisfactory.

"In making the above comparison it should be borne in mind that labor costs in 1918 were at least 30 per cent higher than they were in 1917."

*Pierce-Arrow Trucks on Pennsylvania Road Maintenance*

Since 1916 the Barrett Company, operating a fleet of 35 Pierce-Arrow trucks, has been caring for a large section of the Pennsylvania section of the Lincoln Highway. These trucks also have been used in the maintenance of the William Penn highway and on state roads in many of the eastern states.

The trucks, used mainly in treating road surfaces, are equipped with tank bodies. They operate economically in a radius of 40 miles from the source of supply.

"Without motor truck distribution, this kind of work would be out of the question because of expense," said the local Pierce-Arrow dealer. "The radius of horse-drawn distributors is small and the loads they can draw are light.

"It is the motor truck that will demand the best roads and it is the motor truck that is making it possible to construct and maintain those roads."

The trucks are sent from Philadelphia and Pittsburgh to the job, while the Tarvia is transported in tank cars. The trucks work out from the cars, and can usually operate economically in a radius of 40 miles. The Pierce-Arrow trucks may leave the plant to which they belong, and be away the entire road building season. In the late fall they return to the plants, are overhauled and put in good condition for the next spring.

These trucks have been handling Tarvia on the National Pike in Maryland and Pennsylvania, on the William Penn Highway, and on state roads in many of the eastern states. They spread three different grades of Tarvia, A, B, and X. Tarvia B is applied cold as a surface treatment, while A and X are applied hot. Much of the Lincoln Highway has been surface treated with Tarvia B spread from Pierce-Arrow trucks.

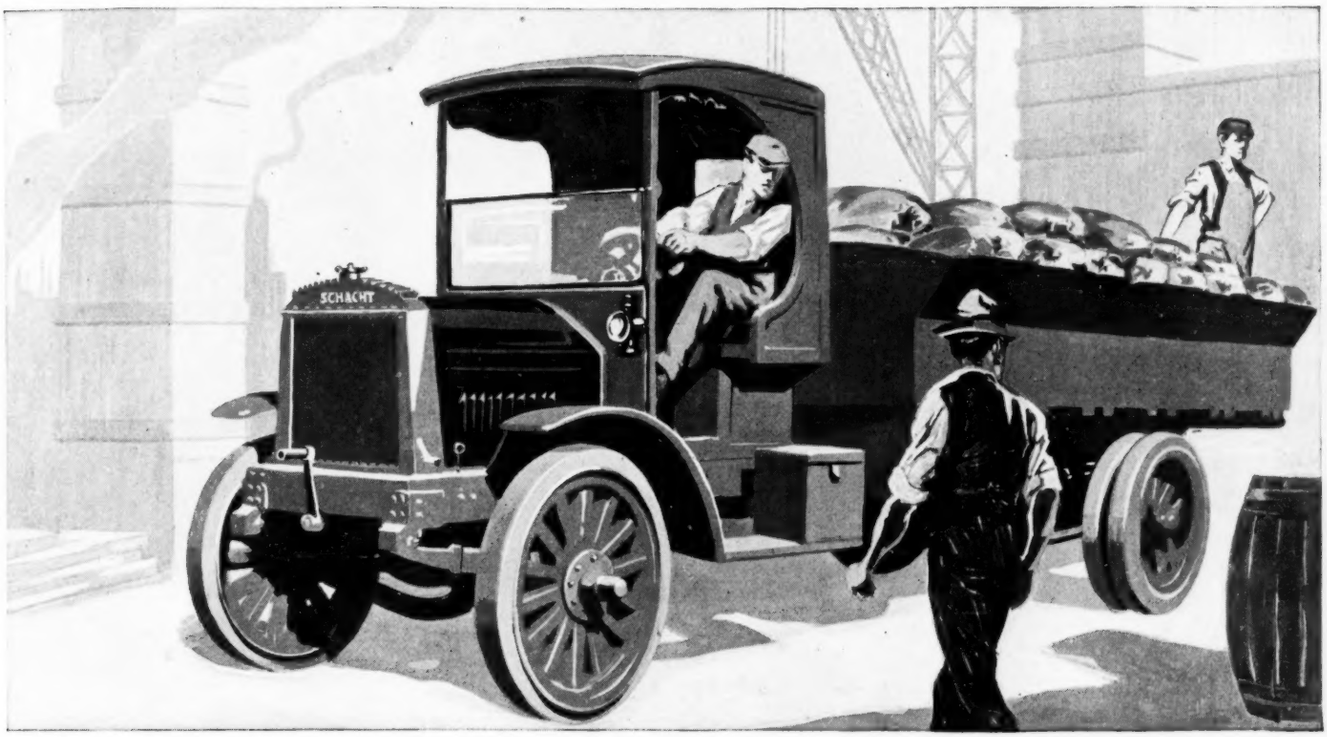
Without motor truck distribution surface treatment of existing roads would be out of the question because of expense. The radius of action of horse drawn distributors is short, and the loads that can be drawn are light. In hilly country a 600 gallon tank wagon requires four horses, and it may demand six on steep hills. It will therefore be seen that economical distribution is impossible with horse drawn apparatus on extensive work. The 1000 gal. capacity motor truck, properly geared, can operate quickly and cheaply over any part of the country, and at any reasonable distance from the source of supply.

*Performance of Gramm-Bernstein Motor Fire Equipment*

The Fire Department of Lima, Ohio, has been completely motorized with equipment built by the Gramm-Bernstein Motor Truck Co., of that city. Before this complete motorization had been effected Mr. John C. Mack, chief of the Lima fire department, wrote the following letter about the performance of the Gramm-Bernstein motor fire apparatus then in use, consisting of five pieces, namely two triple pumpers, one combina-

DUPLEX 4 WHEEL DRIVE TRUCKS IN OPERATION ON COUNTY ROAD WORK.

Top: Duplex Truck owned by Southern Contractor Dragging Muddy Louisiana Road. Center: Duplex Truck Pulling 30 Ft. "Uncle Jim" Road Leveler. An unusual attempt was made to stall the Truck by placing men on each end of the Blade which buried it to a depth of 8 Ins. Bottom: Duplex Truck Carrying 8,000 Lbs. and Hauling Scraper which is Digging 3 Ins. on the Inside and 5 Ins. on the Outside.




# A Big Field for Good Dealers

SELLING Schacht trucks to contractors offers handsome returns to capable dealers with an acquaintance and connections in the building field.

The truck is easy to sell because:

It is thoroughly sound from the engineering view-point—massive, powerful, efficient. Men who know machinery recognize that at once.

The Schacht has made good. It has been in successful service for 11 years and for 7 years has been out of the experimental stage. It is one of the first worm drive trucks to be built in America. The men who make it have built motor vehicles for 18 years.

The Schacht is proved and staple—a truck of established and *known value.*

It is a high-grade truck—built to give long service at low cost. In the contracting field it is yielding ton-mile costs that will bear any comparison. Each Schacht truck in use sells others.

***Write now or wire for the facts. Stop at Cincinnati and go through the plant.***

SIZES:—2, 2½, 3½ and 5 ton.

**The G. A. Schacht Motor Truck Company, Cincinnati, O.**

**Schacht WORM DRIVE Motor Trucks**

tion chemical and hose car, and two tractors, one for the aerial truck and the other for the Nott steamer.

"The first piece apparatus, the Combination Chemical and Hose Car was placed in service on Jan. 15, 1916, and the others followed in fairly regular order. During 1916 we responded to 283 alarms of fire and the machines never failed us once; in fact they went many places where the horses could not go. In one instance the Combination Chemical and Hose Car which is stationed in the Central Department went around the No. 3 horse-drawn rig, which had stalled in the mud, and after putting out the fire returned to where the horse-drawn rig was stalled, hooked on and pulled them out onto the paved street.

"The No. 2 and No. 4 Triple Pumping Machines have rendered us most valuable service in combating many serious fires, having pumped from one to six hours steady without a quiver or a stop and pumping through four lines of hose to each machine. These machines are from 1 to 3 tons lighter than any other make machine, which enables us to travel anywhere no matter what the conditions are, and we have never failed to reach the fire.

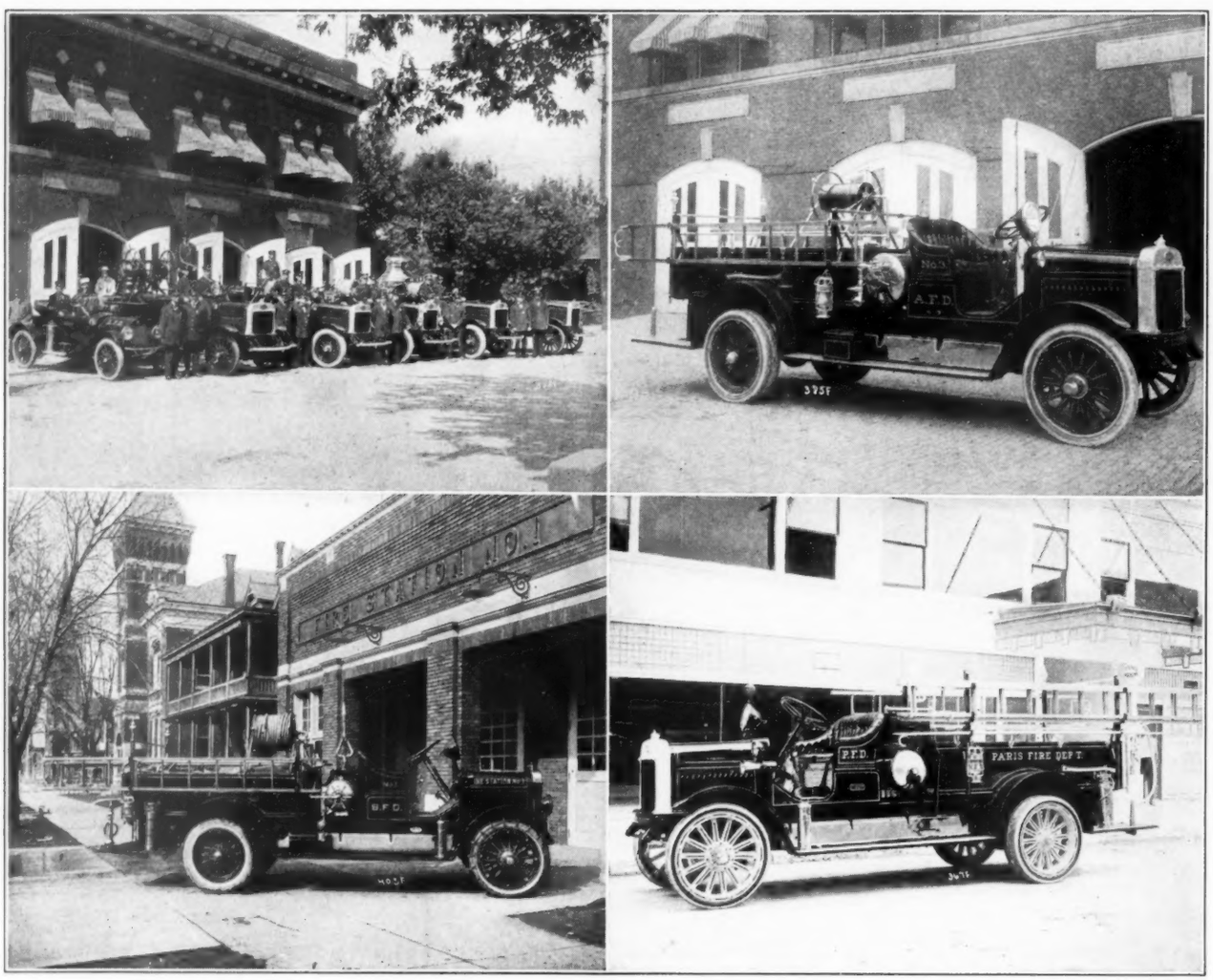
"The actual cost of the maintenance of our machines runs from $1.60 to $3 per month. Our one horse drawn rig costs more per month than the six machines cost, including the Chief's car combined."

*Performance of Federal Trucks on a Variety of Jobs*

Peter Bauer of Milwaukee recently had a contract to haul lime from the lime kilns near Cedarburg, Wis., into Milwaukee, about 19 miles away. He put his 1½ ton Federal to work with 2 drivers, working double shift. This truck made six round trips every 24 hours, hauling 2½ tons per load—traveling 228 miles and hauling 15 tons per day. This is a hard test, especially as the 2½ tons must be pulled up a 20 percent grade in getting away from the lime kilns. The truck made these trips for over a month, without miss. The first trip made on other work was a furniture trip to Mayville, 54 miles from Milwaukee, making the 108 miles on 10½ gal. of gasoline.

The Pennsylvania R. R. Company recently purchased two Federals—of 1½ and 3½ ton capacities—for use at the various Baltimore stations. These two trucks enabled the officials to dispose of two 2-horse wagons and two 1-horse carts. The two trucks are now doing more work and doing it quicker and more economically than four horse drawn outfits—6 horses and 4 men.

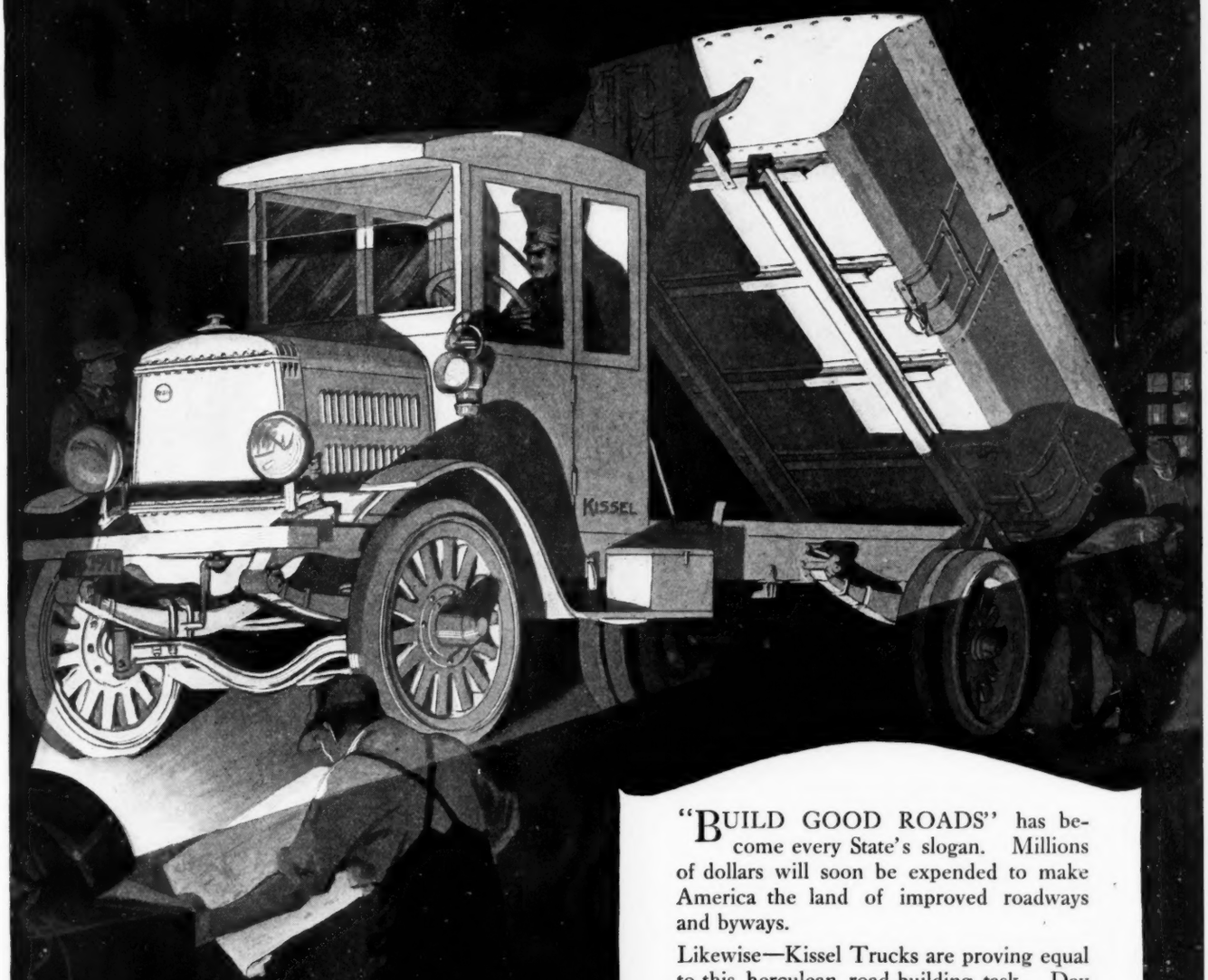
The Templar Motors Corporation of Cleveland, Ohio, made good use of their 2-ton Federal last fall, when The Hoosier Auto Parts Company, of Muncie, Ind., had immediate need of 100 cylinder heads. To send these heads—a total weight of 6,150 lbs., by freight, meant a good deal of delay, and by express, considerable expense as well as some delay. Accordingly, the truck started out with its 3-ton load at 3 o'clock one afternoon. Fostoria was reached that night and Fort Recovery the next night. The cylinder heads were delivered in Muncie




VIEWS OF RECENT INSTALLATIONS OF GRAMM-BERNSTEIN MOTOR FIRE EQUIPMENT.

Top Row: Left—Motorized Fire Department of Lima, Ohio. Entire Fleet of Trucks Built by the Gramm-Bernstein Motor Truck Co. Right—Combination Chemical and Hose Truck Operated at Adrian, Mich. Bottom Row: Left—Combination Chemical and Hose Truck of Standard Design Except Hart Twin Nozzle Mounted on Left Side, as Operated by Shelbyville, Ind. Right—Combination Chemical and Hose Truck as Operated by Paris, Ky.

# Uninterrupted Transportation




"BUILD GOOD ROADS" has become every State's slogan. Millions of dollars will soon be expended to make America the land of improved roadways and byways.

Likewise—Kissel Trucks are proving equal to this herculean road-building task. Day and night, throughout the twelve months of the year—with an incomparable chassis—perfect combination of fixed and moving units—a brute of a power-plant—results of eleven years of motor truck designing and construction experience.

**Kissel Trucks are built for every line of business. There is a Kissel dealer in every principal city—see the nearest one.**

## KISSEL TRUCKS

**Kissel Motor Car Co.**
**HARTFORD, WIS., U.S.A.**

**"Build now the homes, schools, roads and other things the war stopped."**—*U. S. Dept. of Labor, W. B. Wilson, Secy.*

at noon the second day and that night the truck arrived in Coldwater, Ohio, on the return trip, reaching Cleveland the next evening, thus successfully completing a 506 mile trip in 2½ days and delivering the three tons of cylinder heads on good time.

*Service Truck on Road Maintenance*

One of the views shown in this section is of a Service 3½-ton truck equipped with dump body for hauling gravel and materials. The road drag and scraper are attached with a spring

SERVICE 3½-TON TRUCK, EQUIPPED WITH DUMP BODY, DRAWING ROAD DRAG AND SCRAPER ON COUNTY ROAD MAINTENANCE.

hitch. This truck is doing the work formerly done by six teams. This 3½-ton special truck has the same engine as is used in the 5-ton truck and this, of course, gives a great power plant. When this truck was first demonstrated to the county commissioners of Wabash county, Indiana, the gravel roads over which it operated were very heavy, and the gravel stood up fully a foot above the top of the drag in places, yet the truck was able to handle the haul on second speed most of the way. Part of the distance was covered on third but there were times when it was necessary to drop into low. The unit illustrated is equipped with hydraulic hoist and dump body and has given an excellent account of itself on road maintenance work.

*Kissel Freighter Hauls Live Stock*

A truck owner operates a Kissel Freighter model truck, with two trailers, and covers a distance of 29 miles each way in Jackson County, Mo., the county in which Kansas City is located.

On the first load transported, there were 12 head of cattle; on the second load, 13 head of hogs and 9 head of cattle; on the third trip, a load of mixed merchandise; on the fourth trip, 29 head of hogs, while on the fifth were 32 head of hogs. On return trips, general merchandise is hauled for which is charged the same freight rates as the railroads. The hauling is done over rough roads, and while there are a good many hills, the roads are comparatively good.

It can be seen from the gradual increase in the above loads, that the man operating the truck gradually learned how to load it scientifically, and with the aid of the trailers, more than doubled his load capacity after the first load.

*How Motor Trucks Widen the Shipping Range*

"As every motor vehicle manufacturer and dealer knows, sales prospects increase as shipping areas are widened," said C. D. Franks of Indianapolis, in addressing the Indiana Engineering Society, "making the purchase of self-propelled vehicles necessary if the additional marketing points thus opened are to be placed within practical reach of the farm.

"The extent to which motor vehicles widen the shipping range of communities is shown by some very interesting facts gathered by the U. S. Department of Agriculture. In a comparison between motor truck and wagon it was found that the average range of the motor truck haul to shipping points is 11.3 miles, making 3.4 trips per day as against 9 miles by wagon making only 1.2 trips per day. The cost of hauling per ton mile was found to average 15 cents by motor truck against 30 cents by wagon. These figures are based upon 1918 hauling on ordinary roads. With resistance to traction removed to a minimum by concrete roads, even the 15 cents per ton mile cost would be still further reduced by the motor truck, to say nothing of the greater number of marketing points that would be brought within practical, every-day range of the farmer."

"The prediction has been made that, given a rigid, wide and permanent roadbed, the gasoline engine and motor truck will revolutionize transportation. In this transformation lies a great opportunity for the manufacturers and dealers in highway equipment. Already the manufacturer of such equipment has become one of the amazing developments of the decade, a development out of all proportion to that of the roadbed over which the new equipment is operated. Some idea of the immensity of the field now opening to the motor vehicle may be had when we stop to consider that highway mileage exceeds railway mileage by 2,220,482 miles, that highway building is beginning where railway building left off, and that already the public owns its own right of way, which needs only to be surfaced with a rigid, durable material to hasten the full use of the new freight carrier."

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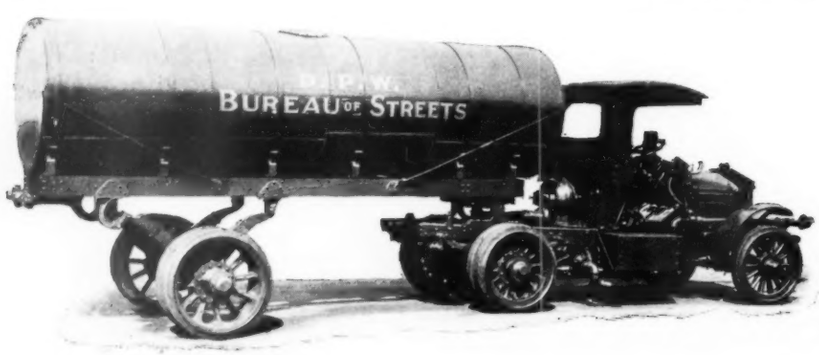
## Relation to Highway Construction and Maintenance of License Fees for Motor Vehicles and Drivers

*By H. Eltinge Breed, First Deputy Commissioner, New York State Highway Department, Albany, N. Y.*

Those who benefit from an improvement should be the ones to pay for it. Like many another obvious truth, that easy-sounding statement conceals the kernel of our perplexity.




PIERCE-ARROW TRACTOR HAULING MUNICIPAL WATER FLUSHER TANK.

# What Jones found out about his motor trucks

## How a real study of the motor truck problem made surprising savings possible

WHEN Jones bought his first truck he was convinced he had purchased the best truck on the market. But a few months later he wasn't so sure. The next time he bought a truck it was a different make. But the new truck seemed to give no better satisfaction than the first and so far as Jones could make out the repair bills weren't anything to have pleasant dreams about.

Naturally he blamed the truck.

"My trucks are costing me a pretty penny," he remarked one day to his friend Wilson, who had dropped into his office.

"Why that's funny," said the friend who happened to be in a business that used trucks extensively. "We are using both

those kinds of trucks and they are giving us splendid satisfaction. Exactly what is your trouble?"

"For one thing," replied Jones, "I've had a lot of trouble with my drivers—delays and the like, and they don't seem to give a rap how they handle the trucks. Then a lot of time is wasted loading and unloading and ....."

"Do you know exactly what your trucks are costing you?" interrupted the friend.

"Approximately, yes; accurately, no."

"Just what I thought—you need a cost system that will show you exactly what it is costing to run your trucks per day and per mile. And you need a lot of advice about other truck problems as well."

"But how am I to get it?"

The friend told him how he could study the motor truck problem and solve the difficulties.

Three months later when the two met, Jones had an entirely different story to tell.

"Say, old man," he said, "that tip you gave me about motor trucks has worked wonders. I have cut my repair bills fifty percent, increased the actual running time 28 percent. And I have only begun to accomplish things. I am not going to stop until my trucks are 100 percent efficient. But honestly, I never thought how much one can learn about motor trucks until I really got down to studying them."

* * *

The Jones story is typical of what hundreds of actual motor truck users have accomplished after devoting part of their time to a real study of the problems involved in the operation and maintenance of motor trucks.

### Helping Hundreds

Unfortunately, as in the Jones story, many blame the truck when it fails to perform as the truck salesman said it would. There are many good trucks on the market and the manufacturer does his best to make his truck of real service. But the best truck a man may buy will not give the satisfaction the manufacturer has designed it to give if he treats it as some big, rough powerful thing that can be abused as much as he likes. The man who uses trucks can increase their efficiency, and save himself many hundreds of dollars, both in their operation and maintenance, and can speed up their work, if he will carefully study Mr. S. V. Norton's new book—**The Motor Truck as an Aid to Business Profits.** A pioneer in this important field, Mr. Norton has, out of his wide experience and intensive investigation, produced a veritable encyclopedia of motor truck facts and figures, and on almost every one of the 530 pages of this comprehensive work may be found some money saving plan, or suggested device that you can perhaps at once apply to your very business, and so increase the life of your truck. "We regard **The Motor Truck as an Aid to Business Profits** as containing the largest amount of practicable information upon this subject that is available in the country, writes W. A. Alsdorf, Secretary of the Ohio Good Roads Federation, Columbus, Ohio. The suggestions contained in it will save many dollars a year to the truck owner. As a business proposition he cannot afford to do without it." Scores of manufacturers, truck owners, and business men everywhere have given their endorsements to this valuable work. An idea of the value that the contents of this book will be to you may be gained from the following list of "hows."

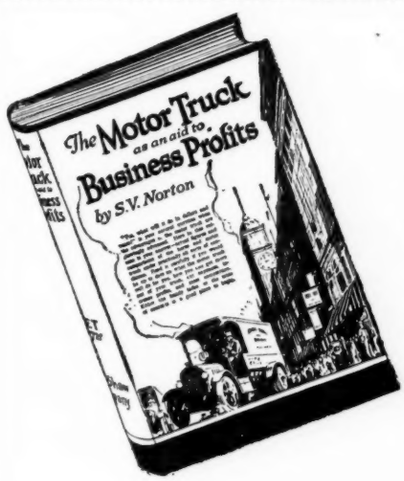
### Consider the Value of one of These "Hows" to You

—How to determine what truck is the best for you to buy.
—How to keep accurate costs.
—How to stop delays.
—How a Chicago concern saved $8,700 in one year's operation.
—How an Ohio contractor reduced the loading time of his truck.
—How to plan your routing to save time.
—How to increase the load carried per trip.
—How trailers save one third on hauling costs, what features to look for when buying a trailer.
—How to speed up unloading.
—How to get your drivers' cooperation.
—Seven rules that save accidents.
—How to install a time recording device that will increase the running time of your trucks.
—How to install a bonus system for drivers.
—How to cut maintenance costs.

—How Captain B. B. Lipsner solved the problem of operating and maintaining a fleet of 600 trucks scattered over a territory of 35 states.
—How to save money through proper lubrication.
—How to stop leaks in the supply room.
—How one chief construction engineer used his trucks to get more business.
—How an Eastern paving contractor delivered asphalt at an increased saving of time and money—and increased the radius of his operations.
—How a loading device enabled one contractor to take in $83.63 in one day with one 5 ton truck.
—How a motor truck association protects the truck owner.
—How to meet anti-legislation.

### No Money Down

The best proof of all is to judge for yourself from the book itself. Send no money. You can examine the book free for ten days. If, at the end of that time, you find the book is a real help to you, and you decide to keep it, send us $7.80 in full payment. If, however, you feel it will not help you, or if, for any reason at all, you do not wish to keep it, return it at our expense, and it won't cost you a penny. In replying please mention Municipal and County Engineering.




**530 pages**
**4 large folding inserts**
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**FREE EXAMINATION COUPON**

A. W. Shaw Company,
5 No. Wabash Ave.,
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I wish to examine free for ten days Mr. Norton's book, The Motor Truck as an Aid to Business Profits. If I wish to keep the book I will send you $7.80 in full payment. If at the end of the time I do not wish to keep it I will return it to you at your expense. M. E. 419

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Canadian price, $8.50, same terms; Foreign, $8.50, full cash; U. S. Colonies, $7.80 full cash.

Who benefits by improved highways and in what proportion? The question involves the economics of taxation; the answers to it are as radically opposed as Kitchin and Lodge, said Mr. Breed in addressing the Association of State Highway Officials at their recent annual convention.

*The Extremes*

They run the gamut from those who would place the entire cost of highway construction and maintenance upon the direct users of the roads, to those who would exempt them and make the general public foot the total bill. In between are the various degrees of compromise, all of them advocating, in different ration, some tax on the public and some on the vehicles. To prepare the way for this middle group let us briefly consider the arguments of the two extremes. Many of them appear in replies to questionnaires that I sent to a number of state highway officials and to representatives of automobile associations and industries.

*The Plea for Exemption*

The strong plea for exempting the direct users of roads and placing the entire cost upon the public, is, of course, that the public is ultimately the great beneficiary.

I may never own a car, or ride in one, but when my child is taken critically ill, his life may depend upon the speed of the good road over which the doctor can reach him. Shall I hesitate to pay my share toward it?

I may never have letters to send or goods to export, yet inevitably the life of my household and business depends upon the receipt of supplies from without. Shall I not help pay for the route over which they travel?

Even though I may never use the public schools I gladly pay the school tax, because through education it enhances the life of the community, and hence my own welfare.

I pay for police and fire protection though personally I may never need either, and I don't demand that people whose houses burn up, or who have burglars arrested, shall pay a special fee. Should I not be willing, as one of the public, to pay for the public benefits derived from good roads, especially as I am bound to receive from them not only a share in the general good, but direct personal advantages?

The argument sounds convincing. It is ably supported by Mr. George Diehl of the American Automobile Association.

*Application of Entire Tax on Public*

An interesting suggestion for application of the entire tax upon the public is made by Mr. Ellis Dutton. Land bordering the highway, whose value is directly increased by it, shall carry the greatest burden of expense; contiguous lands and the general public less, proportioned as far as possible upon the benefits they receive. Says Mr. Dutton: "In every case where streets or roads are paved the increased value of the property is more than the cost of the improvement. Shouldn't these benefited lands pay for the paving * * * and in less proportion contiguous lands and the general public?"

But as in the case of so many other convincing arguments, there is a practical difficulty, not insuperable perhaps, but considerable. The traffic demands for and upon highways are greater than the tax-paying power of the public can sustain. More and more traffic—an increase in New York state of 390 per cent. in motor vehicles in the last seven years—more need for new routes and good maintenance, higher and higher taxes, until the point is reached where the increased cost of the roads does not yield the taxpayers a commensurate return in public benefits. The gain accrues the private pocketbooks. Thence we swing to the opposite extreme that says that the motor vehicles using the roads and directly profiting from them should be the ones to pay for them. I purposely omit horse-drawn traffic here, as being an increasingly negligible factor upon our highways.

*Taxing Motor Traffic for Entire Cost*

Illinois is the chief exponent of taxing motor traffic for entire cost of the highways.

The arguments advanced by Mr. Bradt of Illinois in favor of their arrangements are:

1. The practical difficulties of raising money through a general public tax. The political party in power, particularly in election year, is so anxious to keep down taxes, that it is loath to secure funds for absolutely necessary work. The tax burden in Illinois is already very heavy.

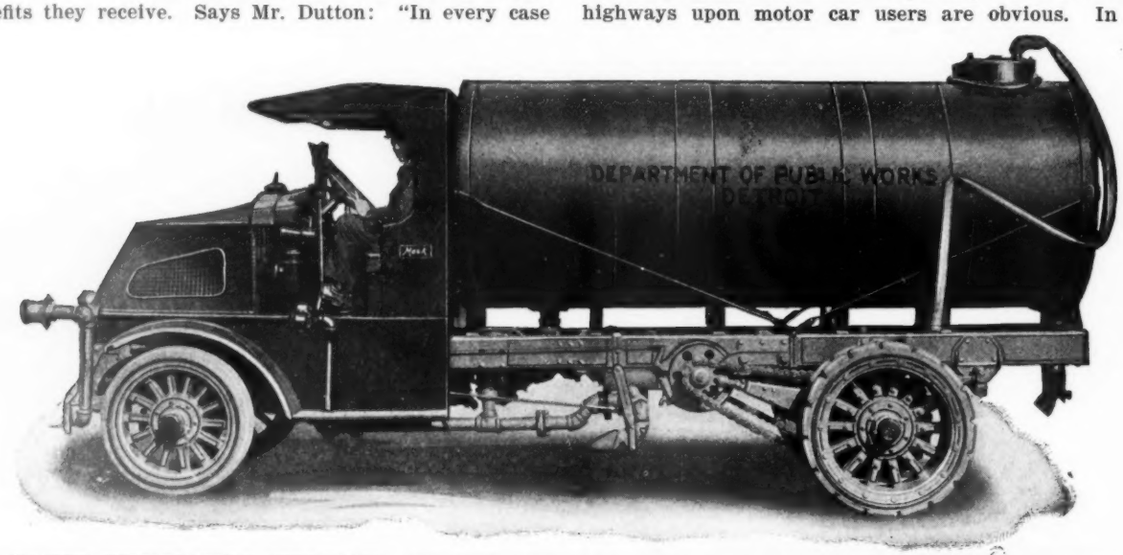
2. The greatest benefits from the roads accrue to the direct users of them. Motorists gain directly through the lower cost of running on good roads, hence the user should pay.

3. The public really pays a share through the increased cost of service and commodities received over these highways.

On the strength of these arguments, Illinois has authorized bonds for $60,000,000 for highway improvement, all of which will be paid from automobile dealers, motorcycle and chauffeurs' license fees, the greater part being derived from automobile fees. The system to be built from this sum will extend 4,800 miles, and, it is estimated, will carry 40 to 50 per cent. of the total state traffic. It comprises, however, only 5 per cent. of the total road mileage. The other 95 per cent. will have to be maintained and improved through general taxation.

So even the state that has gone farthest in taxing vehicles for highway purposes has stopped short of the ultimate, 95 per cent. in mileage and 50 per cent in traffic.

The practical objections to putting the whole cost of the highways upon motor car users are obvious. In the first




MACK 7½-TON COMBINATION SPRINKLER AND FLUSHER AS OPERATED BY THE CITY OF DETROIT, MICHIGAN.

place, even if it were practicable, it wouldn't work—which isn't quite so much of a bull as it sounds. It wouldn't work because all cars engaged in any kind of public service—by far the greater and more destructive number when you include the motor trucks—would immediately charge the expenses of the fee to the cost of their services, increasing the price to the consumer, so that the public would be paying just the same, only a little more so, for the benefits it receives via the highway route. Indirect taxation may tickle the palate, but it's fundamentally bad for financial digestion. The relatively small number of car owners that do not perform any public service for which they charge would bear the brunt of disproportionately high taxation. This immediately raises the question of how far we believe in class taxation. Is it, or is it not justifiable?

Moreover, I don't believe it is generally practicable to raise highway funds exclusively through taxation of vehicles. It would tend to limit the number of vehicles, and the fewer these were the more each one would have to pay, until the limit that any one could endure would be reached. Then the roads would have to suffer—less new construction, poorer maintenance, until the public realizing that the loss of good roads was costing far more than the taxes necessary to sustain them, would rise up and demand that they be continued.

### *Theory of Marginal Utility*

It is really the theory of marginal utility that adjusts the difference between the two extremes and offers us a working basis. The public is willing to pay up to the margin where the utility it receives from the road compensates the money outlay in taxes. Beyond that it cannot economically go. But so great is the destruction of the roads under heavy traffic that taxes on this basis will not meet the entire cost of maintenance and desirable new construction. The difference must probably be met by a tax on vehicles. Now the vehicles are willing to pay up to the margin where the tax levied upon them is commensurate with the especial value that they, as direct users, receive from the road in distinction from the non-direct-using public. Believing therefore that both classes of beneficiaries should contribute toward the support of highways, it remains to adjust the balance between them.

The point of marginal utility for the public seems to be reached at paying for the construction of new roads. The cost of these is great, so is the immediate benefit derived by the public. More exactly than such balances can usually be made, the point of marginal utility for the vehicles seems to be reached at paying for maintenance. The cost of maintenance is great—so also is the damage done by motor vehicles to roads for which the public has paid. I make these two statements a priori, from a study of cost data and of the means taken by the different states to raise the necessary funds for highway purposes. They are, of course, open to dispute. I offer them as an hypothesis, because motor truck fees must be considered in relation to the objects for which they will be used.

### *Connecticut Fees*

If we consider the fees in relation to maintenance, Connecticut offers us some interesting experience. Mr. Bennett, the commissioner there, is working on the theory that the income from motor fees should approach the outgo for maintenance.

Here are the schedules of Connecticut's heaviest revenue producers in fees:

For passenger cars, 50 cents per h.p. per annum.

For commercial vehicles up to 1,000 lbs. $11. per annum.

One ton, $15 per annum.

Then an increase of $5 per one-half ton to the 3-ton weight, $35.

Then an increase of $10 per one-half ton to the 5-ton weight, $75.

Then an increase of $12.50 per one-half ton to the 7-ton weight, $125.

Seven and one-half tons, $150 per annum.

Eight tons, $200 per annum.

Then for each additional ton or a fraction over a ton, $100.

Each motorcycle, $2.

Each chauffeur or operator, $2.

Here are the schedules of New York's heaviest revenue producers in fees:

Passenger cars 25 h.p., $5 per annum.

Twenty-five to 35 h.p., $10 per annum.

Thirty-five to 50 h.p., $15.

Fifty h.p. or more, $25.

For commercial vehicles 2 tons or less, $10 per annum.

Then an increase of $5 a ton up to 14 tons, which is $70; for each ton over 14, $10 per ton.

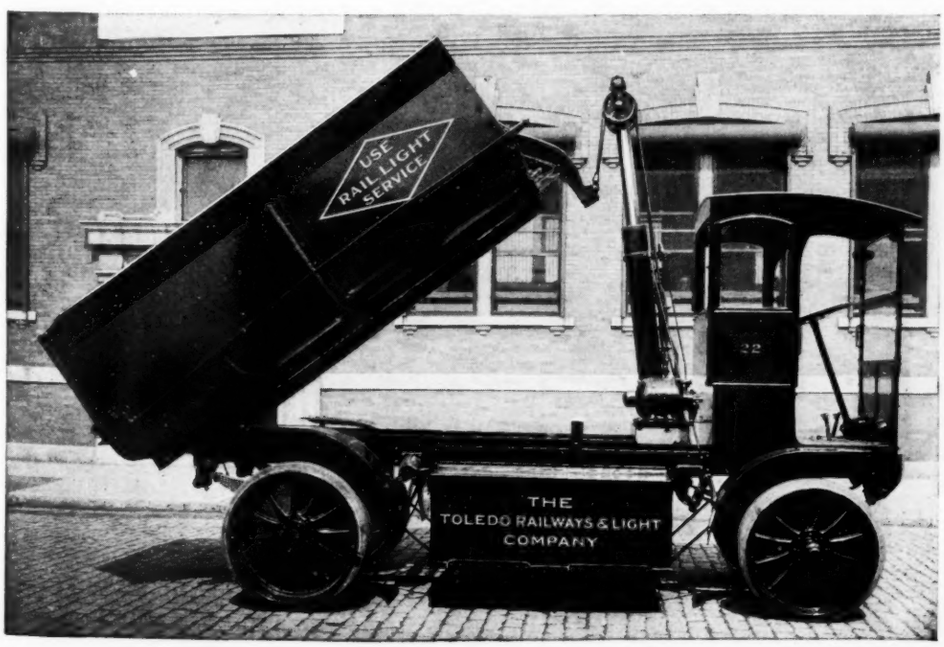
For trailers of 2 tons or less, $5 per annum.

Two to 5 tons, $10.

Five to 7 tons, $15.

Seven to 10 tons, $20.

Ten to 14 tons, $30.




WALKER TRUCK WITH END DUMP BODY AS OPERATED BY THE TOLEDO RAILWAYS & LIGHT CO., TOLEDO, OHIO.

PIERCE-ARROW TRUCK EQUIPPED TO APPLY TARVIA ON PENNSYLVANIA HIGHWAYS.

And $5 for each ton above 14.

For passenger omnibuses:

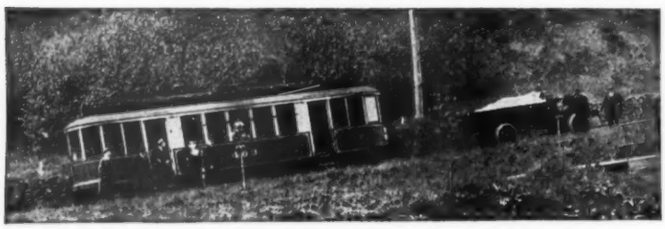
| | |
|---|---|
| Up to 5 passengers | $15.00 |
| Not less than 6 nor more than 7 | 24.50 |
| Not less than 8 nor more than 10 | 30.50 |
| Not less than 11 nor more than 16 | 43.00 |
| Not less than 17 nor more than 20 | 52.00 |
| Not less than 21 nor more than 22 | 55.00 |
| Not less than 23 nor more than 26 | 61.50 |
| Not less than 27 nor more than 30 | 67.50 |
| And an additional $2.00 for each passenger over thirty. | |
| Motorcycles | $2.50 |

Chauffeurs, $5 first year; $3 for license, $2 for examination; renewal, $2.00.

According to motor car owners with whom I have talked, these fees are paid willingly, both as a matter of abstract justice in repairing the damage done by the vehicles themselves, and as a matter of personal interest to the motorist. Thru the payment of fees for maintenance of good roads they assure themselves that they will lower operating expenses, decrease hazards, and curtail delays.

*Importance of Good Highway Administration*

But—here is an important point in considering motor car fees in relation to maintenance. The cost of maintenance depends upon the efficiency of your highway department. Put in incompetents or grafters, and the fees will either go beyond bounds or the maintenance will fall short. The general public is not yet educated to knowledge of and insistence upon the best use of the taxes it pays. It is all up to the motor car users and industries to see that the money for highway purposes be expended by honest men of proven ability. Whether they like to or not they must concern themselves in politics



DUPLEX 3½-TON TRUCK AS USED BY ALEX SMITH, PORTLAND, ORE., IN PULLING 23½-TON LOAD UP STEEP GRADE.

to the extent of securing good highway men in state service for the success of their business depends upon the success of the roads and the success of the roads depends upon highway administration.

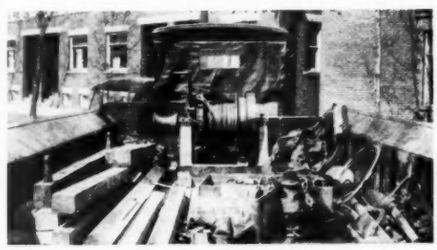
For instance, for years Mr. Bennett has been building in Connecticut durable types of pavement with maintenance charges of one hundred to two hundred dollars per mile per year. A very different proposition from laying Waterbound Macadam with a maintenance of one thousand a mile or upwards a year under heavy traffic. If motor vehicle fees are to cover maintenance wisdom must be shown in laying permanent types of pavement for heavy traffic, so that repairs will be kept at a minimum.

The maintenance itself must be well advised and executed. Millions of dollars can be squandered on poor materials or work delayed or done at the wrong time. The proverbial stitch saves nine. The motorist must insist that repairs be promptly made, so that his fee is used to the limit of advantage. In justice to himself he can't shunt off the responsibility upon some unknown official.

*New York Motor Fees*

In New York State, motor fees are a trifle lower than those in Connecticut. For the last two years they have almost covered the cost of maintenance. Last year, fees aggregated $4,284,114; maintenance was $4,939,916. For the nine months of this fiscal year ending November 1st, fees were $4,571,852.75, while maintenance was over $54,000 less. Maintenance is high now because almost all our earlier roads, built to sustain traffic up to three tons, are protesting against traffic ten times that weight. The maintenance includes many complete resurfacing jobs done with durable pavements. As we build better roads, maintenance should decrease, even with increase of traffic. Motor vehicle fees can then be lowered. They will probably be close to the scale now advocated by the Highway Industries Association in its uniform Motor Vehicle Traffic Law.

Another important point to consider in relation of motor truck fees to maintenance is limitation of damage that any one vehicle may do to your pavement. It is manifestly unfair



FEDERAL TRUCK EQUIPPED WITH 4,000-LB. WINCH, AS OPERATED BY THE CITY OF DETROIT, MICH.

to expect all motorists to pay for the destruction done by a few excessively heavy trucks. As unfair as to expect the public to pay fifty thousand a mile for new roads to sustain such trucks. There must be an arbitrary limit of load for which we can design our roads. Otherwise, as fast as they are built, roads will attract to themselves traffic heavier than they are designed to bear. The road and the load will be forever outstripping each other, with great economic loss both of the original investment in the road and in the appallingly high maintenance. In addition to regulation of weight of load, there must also be regulation of other destructive factors, such as

width and kind of tires, springs, speed, etc. If, after our roads are built in accordance with these regulations, it seems in course of time desirable to put much heavier loads upon them, we may well consider the suggestion made by Mr. Whinery, that we lay narrow gauge tracks on either side of our pavement to carry the heavy trucks.

*For a Graduated Scale*

With these regulations, it is obviously only fair to proportion the fee to the vehicle in accordance with its probable requirements upon maintenance funds. It would not be fair to tax the little two passenger fliver the same amount as the 12-ton truck.

Mr. Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York City, says: "The plan of grading the annual fee in proportion to the gross weight and carrying capacity is rational and it might well go further and make the total width of the vehicle, where such width exceeds 7 feet, an element in the determination of this fee."

The fees should undoubtedly be graduated in accordance with the destructive factors to the road of the vehicle in question. Such a graduation is now made in many states. I purposely refrain from bombarding you with masses of figures.

A graduated scale of motor vehicle fees to cover the cost of highway maintenance necessitated by the cars themselves, would not, I believe, fall too heavily upon any one. There are, of course, objections to it, but it seems to me the fairest adjustment yet made in taxation between the vehicle and the highway, the motorist and the public.


## Cuts Expenditure of Time and Money in Half

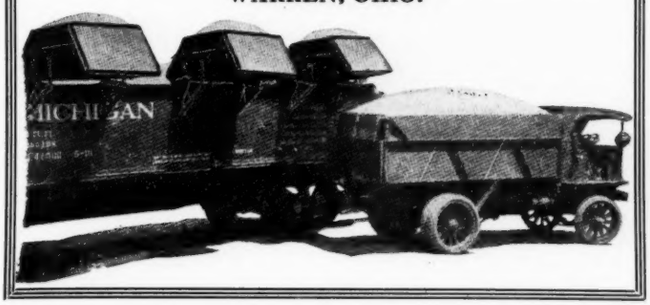
A saving of 50 per cent in Wages and Time is credited to the **Heltzel "Lightning" Loader** by William G. Tonkel, County Highway Superintendent of Allen County, Fort Wayne, Indiana.

By installing two "Lightning" Loaders he was able to dispense with five men. He found he could load a 2½-ton truck in 30 seconds. On the work in question the loaders so speeded up operations as to make one truck do the work of two.

This is a record of performance to command the attention of all.

*Get Prices now from the*

**Heltzel Steel Form & Iron Co.**
**WARREN, OHIO.**



## The Burch Stone Spreader Reduces Cost

**Of Spreading Broken Stone on Roads and Streets while Spreading it Uniformly According to Specifications**

This Spreader practically eliminates labor, and entirely eliminates rehauling and shoveling. Its use conserves stone by eliminating waste, yet keeps the thickness of the stone at the full specified depth at all points. On a single job the saving in stone will often much more than pay for the Spreader. The adjustable steel gate spreads stone much more evenly, accurately and quickly than can be done by hand.

The **Burch Stone Spreader** can be attached to any motor truck. Using the wing attachment it spreads the stone the entire width of the roadway. To thicken the crown of the road the wings are raised higher in the center than at the ends.

This is just the machine the road builder has been waiting for. One contractor saved enough stone on two miles of road to pay for his Burch Spreader. He also saved on labor, and at the same time met the specifications to the satisfaction of the engineer.

**Burch Stone Spreader in Operation**

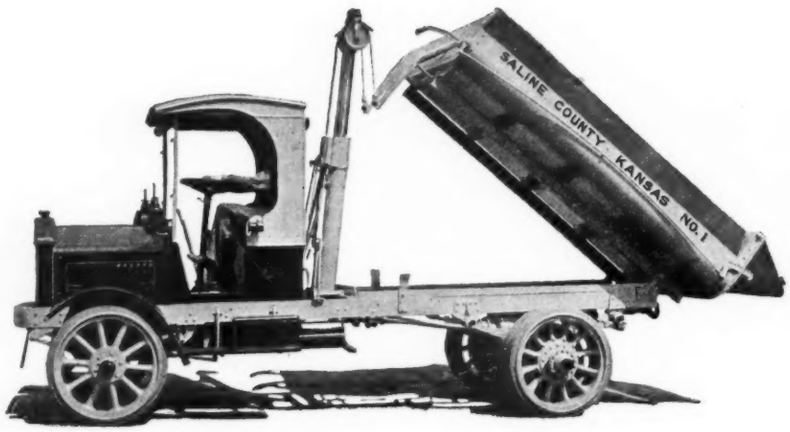
***Get Prices and Full Particulars from***

**THE BURCH PLOW WORKS CO., Department A Crestline, Ohio.**

# Hall Road Builders' Dump Trucks

**Are in Action on Public Works Construction and Maintenance in Municipalities and Counties Throughout the United States.**

The Hall truck here shown is No. 1 in the fleet owned and operated by Saline County, Kansas, for general hauling and on road work.




These Hall 3½-ton trucks, equipped with steel dump body and hydraulic hoist, have given great satisfaction in the municipal, county and township field.

For the sake of being specific, here are a few of the counties operating **Hall** trucks: Sequoyah County, Okla.; Lincoln County, Okla.; Cowley County, Kans.; Alfalfa County, Okla.; Pierce County, Wash.; Leavenworth County, Kans.; Bingham County, Idaho; Randolph County, W. Va.; Roane County, W. Va.; Kanawha County, W. Va.; Marion County, W. Va.; Wyandotte County, Kans.; etc.

Many townships also own and operate **Hall** trucks, including the following: Logan Twp. (Altoona) Pa.; North Union Twp. (Uniontown) Pa. (just bought second **Hall**); and Dunbar Twp. (Connellsville) Pa. (also operate two **Halls**).

The **Hall** has a ***Proud Performance Record*** in the Public Works Field.

It is not only on the rough roads of the county and township that the **Hall** has proved its merit, but in city hauling as well. For example, in Detroit one company operated a fleet of six **Halls** in hauling construction materials. One of their 3½-ton **Halls** averaged 54 miles per day and made 7.4 miles per gallon of gasoline. A 5-ton **Hall** made fourteen trips, carrying 3,000 common brick, and carried 42,000 brick in one day of 10½ hours. A team would make only four trips under the same conditions and haul only 6,000 brick. The truck practically did the work of seven teams. Is it any wonder that their seventh truck was also a **Hall**? These repeat orders tell the whole story.

The builders of **Hall** trucks have taken care of all mechanical and structural features, and the users of the trucks are well satisfied.

**"HAUL IT IN A HALL"**

*Why Experiment? Buy a Truck that has made good!*

**THE LEWIS-HALL IRON WORKS**

**Manufacturers of the HALL Truck**

(Established 1873)

Ferry Avenue and Grand Trunk Ry. **DETROIT, MICH.**

# EDITORIALS

## Road Construction in 1919

At the beginning of the construction season the outlook for road construction is very good. The U. S. Department of Agriculture estimates that expenditures for highway work this year are likely to amount to a half billion dollars or even more. On reports received from state highway departments the Bureau of Public Roads recently estimated an expenditure for roads and bridges of $385,000,000, or $110,000,000 more than the average expenditures for 1916 and 1917. To this figure must now be added immediately $50,000,000 and $75,000,000 more on July 1 from Federal funds. The last two figures given refer to sums made available by an extra appropriation of $209,000,000 in the Post Office appropriation bill recently passed by Congress and signed by the President.

David F. Houston, Secretary of Agriculture, considers the status of road work in the various states and the good roads sentiment highly encouraging. In addressing the representatives of 27 eastern, southern and middle western state highway departments, the Secretary recently declared his belief that highway work should be resumed immediately, notwithstanding the present costs of materials and labor, and that such a procedure would be the cheapest thing in the end for the country at large.

More than 100,000 men will be employed on active road work and there will be many thousands of others employed in the production and distribution of road building materials.

## The Construction Season is Here

Since the signing of the armistice there have been great hopes of extensive construction operations to be undertaken in 1919. The eyes of the construction industry have been turned toward the opening of this construction season with that intent expression worn by those who watch and wait for the morning. Now the construction season is here and it is time to start construction operations in all parts of the country.

There is always a tendency to get the construction season "off center." This tendency is especially familiar to all who have worked on railroads. On railway construction there is usually a much belated and frenzied start which necessitates expensive and doubtful construction work at the other end of the season. The railroads are not the only offenders in this particular but they are, perhaps, the greatest offenders and, having no friends, may safely be cited.

The tendency toward procrastination in actually starting construction will be rather more pronounced than usual this season, it is feared. Added to all the usual excuses and reasons for wasting good construction days in the spring we now have the high cost of labor and materials. Unquestionably, many local authorities are holding back on account of present prices and will continue to do so until forced to act or until convinced that prices are not artificially high. Some of these local authorities must be convinced that prices will not soon come down and may even get higher than at present before starting downward toward the pre-war level. The sooner this conversion is experienced the better for all concerned. The most important, and perhaps the most difficult, duty now confronting the construction industry is to convince some public officials that there is no profiteering in the materials of construction. This can be done and it must be done or many improvements will be still further postponed.

There is no reason to suppose that prices will come down this season. They may not come down for five years, as was the case following the Civil War. Meanwhile, the frost is about all out of the ground. Now, if ever, is the time to start construction operations.

## Local Politics and Prices

It is asserted by one observer that some local authorities, with a tender regard for their political fortunes, hesitate to build at present prices fearing that the opposition will make political capital of such a use of public funds. If, and where, this condition obtains the timid official will need do no more in self-defense than marshal a few of the available facts. Almost every important official in the executive branch of the federal government has urged immediate construction at present prices. That should be sufficient backing for any local official.

It should also be recalled by the hesitating official that all prices are high now and that the increase in costs of construction are less than the increase in cost of almost everything else. Construction prices before the war were too low. Many engaged in the industry were losing money and have just found it out. Improvements are cheap even at present prices when benefits are considered.

It is just as patriotic to build now as it was held to be patriotic to refrain from building during the war. Every economist of note urges extensive building now as the only known and approved method of keeping labor profitably employed and contented. With all the unrest there is among the laboring class throughout the world today it is a risky thing to keep men in idleness because prices are higher than before the war. It is a poor politician who can't defend himself for building now.

## A Well-Considered Engineers' License Law

It is high time for engineers to give careful thought to all proposals having to do with the registration and licensing of engineers. This is true because this matter is rapidly assuming definite form; the period of flux is drawing to a close. A very few years ago this was one of the topics of discussion which did not promise to become more than something to talk about. That much progress toward licensing engineers has been made is unmistakably indicated by the fact that such license laws were recently introduced in the state legislatures of California, Colorado, Michigan, Mon-

tana, Ohio, Oregon, Iowa and Indiana. From this it appears that those who hold opinions on this subject will do well to speak up now or forever hold their peace.

The American Association of Engineers has made good, as usual, by offering a well-considered license bill for the guidance of the profession. The bill appears in the March issue of the Monad, the organ of the Association, and those interested can, and should, obtain a copy.

The bill is the work of the committee on legislation of the Association. Mr. L. K. Sherman, chairman of the committee, was especially well fitted, by training and experience, for the task of drafting the bill. To a great extent this is a combination of bills that have gone before. About fifteen existing and proposed licensed laws were examined, and the recommended bill embodies all the features recognized as essential in the existing laws.

The bill impresses one as being entirely fair to the competent engineer or surveyor and in the public interest. No effort will here be made to discuss the bill in detail. The reader should obtain a copy of it and do his own discussing, which would be more to the point.

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### If for Railroad Engineers Why Not for Municipal and County Engineers?

At the time of writing announcement has been made of a conference at Chicago of professional engineers in the employ of railroads for the purpose of adopting a schedule of monthly salaries for such engineers. Such a schedule was recently recommended to the United States Railroad Administration by the American Association of Engineers. The suggested schedule is to come up for consideration and possible revision and adoption. It is especially interesting to note that the rank and file were invited to attend as well as the men in the higher positions. Many railroad engineers of the highest standing are co-operating with their subordinates and the Association in this attempt to improve the financial status of railroad engineers. It is understood that the Railway Administration is favorably disposed toward the proceedings. A later issue of this magazine will report the action taken at the conference.

Many of our readers have doubtless worked for railroads and, but for the grace of Heaven, still others might have done so. All will recall how securely the average railroad engineer has been tied to the tail of the capitalistic kite and how ardently he has championed private ownership and management of the railroads. Yet under government operation he gets his first view of the promised land. The surpassing beauty of the present opportunity lies in the fact, that the Railroad Administration can, if it so elects, simultaneously raise the pay of all professional engineers in railroad service throughout the country without regard to the road employing the engineer or his previous condition of servitude.

But if the railroad engineer has been in a difficult position what can be said of the position of the municipal or county engineer? The rewards of engineers in public service have been little, if any, better than those of the railroad engineer and their positions have been less secure than his. Municipal and county engineers are not only inadequately compensated for their services but they are likely, through no fault of their own, to lose their positions at any time because of the ruthless workings of the political machine.

What can they do about it? A great deal, if they will. If the American Association of Engineers can help railroad engineers why can it not also help municipal and county engineers? Perhaps it can. Has anybody sought the aid of the Association in this connection?

Entirely on his own responsibility the editor ventures to express the opinion that the Association, if urged to do so, would call a conference of engineers, engaged in public service, for the purpose of discussing ways and means for increasing the compensation of municipal and county engineers and for making their positions more secure. Is there any demand for such a conference?

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### Testing Attitude of Political Candidates Toward Engineers

That the practical politician has, or can be made to take, an interest in the trained engineer was recently demonstrated in Chicago.

The Chicago Chapter of the American Association of Engineers has been taking an active part in the local mayoralty election. Before the primary election the Association secured a definite statement from each candidate with respect to his views on: adequate compensation for the engineers in the city service, the employment of technically trained men for engineering positions, and the selection of properly qualified men for the sixty day appointive positions which are not under civil service regulation. Some very complimentary letters were written by the candidates in which they expressed their admiration for the qualifications and accomplishments of the trained engineer even in making the sixty day appointments. Undoubtedly the case of the engineer in Chicago has been strengthened by this simple expedient of getting the candidates to commit themselves.

The reply of Robert M. Sweitzer, at present County Clerk, is here quoted as it is typical of all the replies and more especially because Mr. Sweitzer is one who safely negotiated the primary election hurdle:

"I am in favor of engineers in the city service receiving remuneration compatible with the service rendered. As Mayor I shall be in sympathy with the scale proposed by your Association, as I have supported the scale proposed by the draftsmen who are employed in my office at the present time, and who, I understand, are members of your Association.

"As Mayor, no sixty-day men shall be appointed to technical positions unless they are technically trained men, fully capable of performing the duties to which they are assigned; and, further, it shall be the policy of my administration to hold regular examinations so that eligible lists shall be constantly posted, thus obviating the necessity of such sixty-day appointments."

Granting that pre-election promises are not always translated into post-election performances it must still be urged that a pre-election promise is much better than no promise at all. Politicians have the virtue of intense practicality and can be depended upon to advocate the cause of the trained engineer when they are made to understand it. This for the reason, of course, that the cause of the competent engineer when presented by a candidate to the public is a very dependable vote-getting device.

## Building New Concrete Shoulders to Preserve the Old Macadam Roads of Maryland

*By John N. Mackall, Chief Engineer, Maryland State Roads Commission, Garrett Bldg., Baltimore, Md.*

The serious problem confronting a great many state highway departments and especially the highway department of Maryland is to preserve old macadam roads constructed before the coming of the extremely heavy motor traffic of today, in a manner that will amply take care of this traffic without a tremendous loss of investment in the old road.

### *The Philadelphia-Baltimore-Washington Road*

In Maryland, the road in particular from Philadelphia to Washington through Baltimore presents this condition. This road was constructed of water bound macadam 14 ft. in width, and from 6 ins. to 8 ins. in thickness over a period of 1906 to 1910. At this time, a road of this character amply met the conditions. It, however, does not meet them today, because the road is probably long enough, but too narrow and too thin.

Macadam roads as such, it is generally conceded, will not, without excessive maintenance, stand the tremendous traffic to which this road was subjected. Therefore, there was one of two alternatives which presented themselves,—either widening the old road in a substantial manner, or constructing a new one. During 1918, the road was subjected to a tremendous amount of heavy hauling, largely by the government direct, or by contractors engaged directly in government or war work. To reconstruct this road, therefore, with any hard surfacing would mean closing it to traffic or detouring, which would have amounted to closing the road to traffic, since none of the by-roads would withstand this amount of traffic.

### *Concrete Shoulders.*

It was decided, therefore, to construct along each side of this macadam road a strip of concrete 3 ft. in width and 8 ins. in thickness. This would give the road a width of 20 ft. which seems to be ample for this time.

The crown of these macadam roads when built was ½ in. to the foot. This crown had been maintained, so that the road had about 3½ ins. of crown, and the steepest part of the road was near the edges. Roads with excessive crown are only used in the center portion, because there is considerable danger of sliding in the gutters where the travel is on the side, so it was decided to remove some of the crown from the road at the same time it was widened. The cross section of approximately ¼ ins. to the foot was decided upon for the existing macadam, and the cross slope was made ¼ in. to the foot in the concrete. This raised the edge of the concrete above the edge of the adjacent edge of the macadam from 1 to 3 ins. The section of macadam adjacent to the concrete was brought up to present a uniform cross section with the concrete shoulder.

### *Procedure in Construction*

This method of construction permitted of the use of the entire section of the macadam road and one shoulder during the course of construction, which gave the maximum use of the present surface during the construction of the addition. The second shoulder was never constructed until the macadam adjacent to the one first constructed had been brought up to the proper cross section.

This work was awarded to two contractors, one on the section of the Washington Boulevard between Laurel and Relay, and the other on the Belair Road between Perry Hall and Belair.

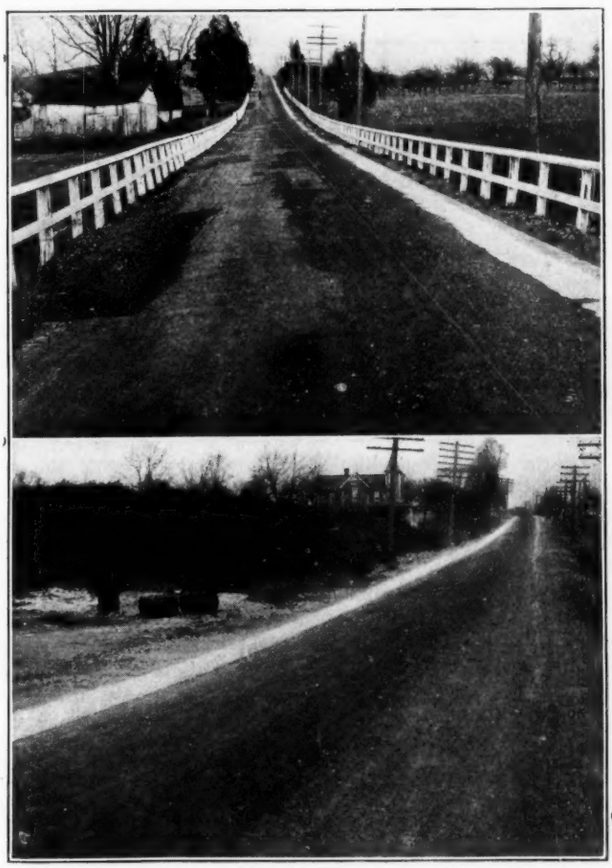
### *Work on First Section*

The contractor on the first section used a one bag batch mixer which ran over the trench where the concrete was being placed, mixed his concrete on the ground and deposited it in place. The contractor on the second contract used a central mixing plant and transported his mixed concrete to the site, dumped the trucks approximately in the trench and shoveled the concrete in place.

### *Work on Second Section*

The work of the second contractor will be briefly described since the method was unusual and the results extremely satisfactory. The contractor had his own quarry and crushing plant within a few hundred feet of the center of the 12 mile section. The stone used was trap rock with a co-efficient of wear of approximately 18, and the quarry was well stripped and thoroughly cleaned.

The material was passed through a revolving screen with circular openings ⅜ in. diameter. All the material except the tailings which went over this screen was used as a coarse aggregate. It was found that the material through this screen, which was used with the sand, amounted to about 25% of the fine aggregate. The sand was hauled to the site in motor trucks and carried to the bins through the screen in the same elevator which carried the stone. This made, then, a coarse and fine aggregate in two sections in the same bin.



USE OF NEW CONCRETE SHOULDERS TO PRESERVE OLD MACADAM ROADS IN MARYLAND.

Upper View Shows Concrete Shoulder on One Side Only, Belair Road Near Baltimore. Note New Macadam Adjacent to Concrete. Lower View Shows Concrete Shoulder on Both Sides on Belair Road. The Shoulder on Right Still Covered With Stone Chips.

A hopper, holding 4 and 8 cu. ft., respectively, of fine and coarse aggregate, was made so that it could be filled directly from the bin and dumped in the concrete mixer simultaneously. This insured uniform quantities of fine and coarse aggregate with a minimum of labor. The concrete was mixed for a period of one minute and deposited in dump trucks which hauled it to the job. It was found that by making concrete which contained no excess water that it could be handled extremely satisfactorily. The concrete was made so dry that when hauled to the job even a distance of 6 miles, there was no excess water on top of the load.

### *Advantage of Central Mixing Plant*

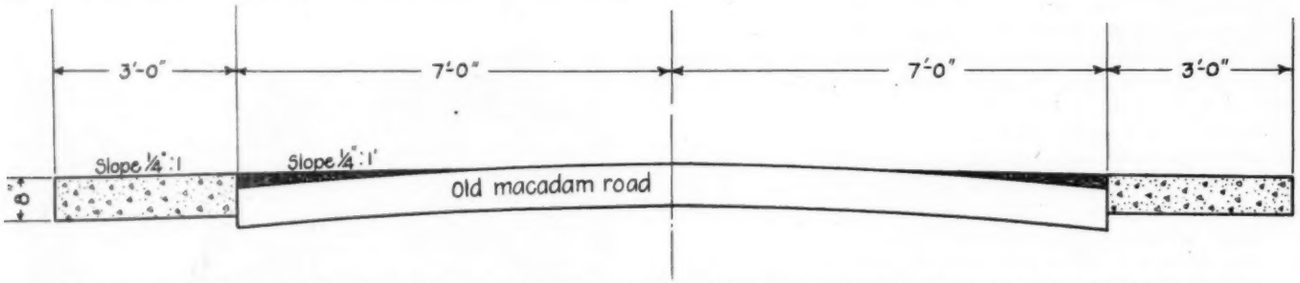
When concrete is mixed on the road in a two bag batch

mixer, 30 men are about the minimum required. By hauling from a central mixing plant, there was only required one man to see that the sand bin was filled and dumped, one for the stone, one for the cement and the engineer on the mixer. On the road 6 men shoveled the concrete in place and one man finished it. An average day's run was 800 lin. ft. of 1:2:4 concrete 8 ins. thick and 3 ft. wide.

*Mixed Concrete Hauled 6 Miles Before Placing*

The work was not started until September, so it is impossible to tell, from this job, how far concrete could be hauled in warm weather, yet we did haul this concrete six miles before depositing it, and the results were much more satisfactory than from concrete mixed directly on the road. This, of course, does not demonstrate that concrete can be mixed and hauled to an ordinary road job in trucks, because it is impossible to operate these trucks over the finished sub-grade. It has demonstrated, however, to the writer's satisfaction that the hauling of concrete properly mixed a considerable distance is a very feasible proposition, and when the industrial railway is substituted for motor trucks, it will seem that the same process could be used for making concrete roadway as for making this concrete shoulder.

There is hardly room for argument that concrete mixed at a central plant is more uniformly proportioned and better mixed than any concrete can be mixed on a roadway, and the writer hopes to see this method more extensively adopted in the very near future.




TYPICAL CROSS SECTION SHOWING METHOD OF ADDING CONCRETE SHOULDERS TO OLD MACADAM ROAD IN MARYLAND.

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## Two Types of Hard Surface Roads Successfully Employed in New Hampshire.

*By Fredcric E. Everett, Commissioner, State Highway Department, Concord, New Hampshire*

For a good many years New Hampshire has been the mecca of thousands of summer visitors attracted hither by our beautiful lakes and mountains and it was to accommodate this increasing summer traffic that New Hampshire first broke into the road building game and for the 13 years that the department has been in existence most of our energies have been devoted toward building roads to satisfy a summer traffic.

The tremendous increase in the use of motor trucks within the last few years have brought about certain conditions, especially between large towns and mercantile centers that demand a higher class of road than that originally built and I will describe two types of pavement that have been used with success by this department.

*An Asphaltic Concrete Pavement*

An asphaltic concrete pavement (so-called "Modified Asphalt") has proven very satisfactory for resurfacing gravel and waterbound macadam roads over which increased traffic has necessitated a more permanent type of surface.

Topeka mixture was considered as a pavement likely to give good results with these old roads as a foundation, but the expense of grading the mineral aggregate was considered prohibitive. New Hampshire is particularly blessed with many good gravel deposits and therefore a "Run of Bank Gravel" which would approximate the mineral aggregate in Topeka was sought. A predominence of coarse aggregate led us to change the maximum size of ¼ to 1 in. Several gravel pits were located which when passed through a 1 in. screen would closely approximate the requirements. In some cases the addition of a fine aggregate was necessary but this only in small quantities. Each pit was examined with great care, tests being made every few feet around the face of the pit and by this means it was possible to find an aggregate in one section, which might be lacking in another, and by a proper combination of both the resulting aggregate would fall between the limits for Topeka.

*Mixing and Laying*

The gravel and asphaltic cement is heated separately to temperatures of approximately 3000 F. A revolving drum is used in heating the gravel the maximum temperature of which shall in no case exceed 375 F. at the mixer. The asphaltic cement is heated in standard kettles and shall not exceed 325 F. at the discharge pipe. The asphaltic cement is then mixed with the gravel in an approved revolving mixer in the proportion of from six to eleven per cent. and this mixing continues until a homogeneous mixture is produced, in which all particles are coated uniformly. The amount of asphaltic cement between six and eleven per cent. is determined by the voids in the mineral aggregate. The asphaltic cement used is from 55 to 75 penetration.

The asphaltic mixture is hauled to the work in tight vehicles previously cleaned of all foreign materials, and if necessary, covered with canvas of sufficient size to protect the entire load. The mixture is laid upon the base course which has previously been made to conform to the new cross-section and thoroughly rolled so as to be free from all loose material. The mixture is between 250 and 280 F. when laid. The entire load is distributed into place and raked to grade in a uniformly loose layer of such depth that after receiving ultimate compression by rolling it shall have a depth of 2 in.

Extreme care is taken to make sure that the mineral aggregate keeps within the prescribed limits. This is accomplished by "control tests" conducted whenever a change is noted in the pit, which might affect the size of the aggregate. Tests are also frequently made for the asphaltic content so as to ascertain if the percentage is being maintained.

New Hampshire has sections of this type of resurfacing (over both gravel and macadam) which have been under heavy traffic for three years and are still giving excellent results.

*Used on Federal Aid Projects*

The past season we have built two large Federal Aid Projects with this type of construction. The first one between the Massachusetts line and the city of Nashua, a distance of 3½ miles. In this case we were able to use the native material following the specifications as outlined above.

The second project between Massachusetts and the town of Hampton on the main road to Portsmouth a distance of 4½ miles. The gravel in this section of the State is much coarser and in order to get the proper grading it was necessary to run the material through a crusher. Everything that passed

through a 1 in. screen was used in the top pavement and the coarser material was used in a 4 in. subgrade or foundation course. It was also necessary at certain times to use limestone dust to supply the necessary fine aggregate.

*Concrete Roads*

The first piece of concrete road in New Hampshire was constructed during the season of 1918. A section of highway, with which some drainage difficulty had been experienced, was selected so that a test might be made as to the effect of frost action under our severe climatic conditions.

This section of road is located near the foot of a long ridge and runs nearly parallel to the crest of the ridge. This ridge makes a large watershed which presented difficulties which had to be overcome to obtain adequate drainage before concrete construction could be considered. The downward percolation of water over this entire slope was considerably retarded owing to an underlying retentive impervious stratum. In addition to the rainfall several springs were observed a few hundred feet from the road. These conditions necessitated not only drainage structures for the "run-off" but also sub-drains to intercept general seepage and lower the water table in the foundation of the road.

*Sub-Drains*

Several types of drains were considered but owing to natural obstacles the standard types were not thought to be efficient and a sub-drain was designed 4 ft. 3 in. deep, 20 in. wide at the bottom and 30 in. wide at the top. After the ditch had been dug true to grade, 3 in. of concrete was placed in the bottom and before initial set had taken place two flat stones were imbedded on edge in the concrete allowing a foot opening between them. As soon as the concrete had set sufficiently cover stones were placed and the remainder of the ditch filled with small cobbles. On top of these cobbles a 6 in. concrete surface gutter was constructed. Corrugated metal culverts were used to carry this surface water across the road and directly below each corrugated metal pipe tile pipe was laid to take care of the water in the sub- drain. To date the results obtained have been excellent.

The pavement itself was a 1 course concrete constructed over an old waterbound macadam, which was first scarified and shaped to make a flat sub-grade. The concrete was a 1:2:4 mix laid 16½ ft. wide, 7½ in. thick at the center and 5½ in. at the shoulders. The course aggregate, the gravel stones passing a 2 in. round opening and the fine aggregate was the sand screened from this gravel. All tests made during the work showed this sand to compare better than 100 per cent. with Standard Ottawa.

The transverse joints were made with three thicknesses of three-ply asphalt felt and was spaced 40 ft. The felt was cut flush with the surface and painted over with the bitumen.

The surface of the pavement was struck off with a strike-board or templet. A concrete roller was then used and the final finish was obtained by the belt method.

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## The Reconstruction of Worn Out Macadam Upon a State Road in Rhode Island

*By I. W. Patterson, Chief Engineer, State Board of Public Roads, Providence, Rhode Island.*

Approximately two-thirds of the total mileage of state roads in Rhode Island is surfaced with waterbound macadam which is in varying states of preservation. Plain macadam was the pioneer type of construction in the building of our state highways, as it was in many states which undertook the building of state roads at an early date. The first state roads in Rhode Island were built in 1896, and at that time and for a number of years following macadam was generally considered to be the ideal surface for surburban roads.

*Early Roads Narrow*

A clause in our state highway law until recently limited the width of state roads to 14 ft., not including earth shoulders, unless the towns in which the roads were located paid the entire expense involved in constructing greater widths. No compulsion could be exercised over the towns in the matter of paying for extra widths and it happened very frequently that heavily travelled roads passed through towns which did not desire or were unable to spend the money necessary for the building of roads as wide as they should have been built. The cost of the old macadams was low. The average total cost was approximately $6,000 per mile. It is apparent that this cost did not allow of extensive drainage work, or a great deal of foundation work or of heavy grading. Local rock was employed very largely in the building of these macadam roads. The character of the rock in Rhode Island varies greatly, and it happened occasionally that crushed stone of inferior quality was employed.

*Traffic Changes Called for Reconstruction*

The effect of present day traffic upon these narrow roads of cheap construction is so apparent that it is needless to enlarge upon the subject. It is a fact, however, that these roads carried successfully for a number of years the traffic for which they were designed and they were doubtless worth all that they cost.

Rhode Island was rather dilatory in taking steps to reconstruct the old macadam roads when the tremendous changes in character of and amount of highway traffic made such a course necessary. The financing of maintenance furthermore was so erratic that much difficulty was experienced in keeping the old macadam in reasonably serviceable condition. The accumulative effect of stopping or seriously retarding the maintenance of roads of this type we know from experience.

*Reconstruction of Worn Out Macadam the Big Problem.*

Reconstruction of our wornout macadam is our big problem today. The building of all of our main trunk lines was completed six years ago and this fact together with the fact that many miles of our constructed state roads are in deplorable condition causes reconstruction to overshadow in importance the building of new state roads.

This task of reconstruction was begun in earnest in 1916 and much has been accomplished since that time. There remains, however, a great deal to be done.

*The Putnam Pike*

The reconstruction of narrow and wornout macadam surfaces upon the Putnam Pike which is here described is typical of the work which we are doing throughout the state. The macadam upon this line was built in the period from 1903 to 1906 inclusive and was in a large part laid to a width of 14 ft. The rock employed in constructing the macadam was a coarse grained granite, some of which was noticeably kaolinized. The surface was very badly worn and out of shape. The crown to which the macadam was laid had disappeared very largely, the surface in places having a decidedly inverted transverse slope. The cross section to which the road was originally built provided in both cut and fill earth shoulders 3 ft. wide and sloped from the edge of the metalled surface ¾ in. per foot.

Foundation difficulties and imperfect drainage facilities were very pronounced upon the old road. At times in the early spring when the ground was thawing certain portions of the road were practically impassable because they became so soft. Certain sections of the road on the other hand never became soft. The traffic upon this line is heavy in character and fairly heavy in amount. It is estimated that the number of vehicles passing over the road annually at present is approximately one-half million. There is a great deal of heavy motor trucking over the road of farm products and of mill supplies and mill products. Loads weighing between 10 tons and 15 tons including the weights of the vehicles are very common, and greater loads than 15 tons are not unusual. A number of mills located near this road influence the extent of trucking over the

road greatly. The travel over the road is very uniform in amount throughout the year. During the winter and early spring there is no falling off in commercial vehicle traffic and very little lessening in the numbers of other types of vehicles. The character of the traffic over the road made necessary a very careful study of foundation difficulties and also called for a width of new metalled surface greater than the existing width of 14 ft.

*Foundations*

Because of the fact that the road had been surfaced with plain macadam and had been under observation for a number of years, the design of foundations was simpler than would have been the case if the road surface had been merely of earth or if the road were to be built in a new location. A careful examination of foundation conditions which had caused trouble in the past was undertaken. The most valuable information was obtained at a time when a winter thaw was experienced.

The sections which showed evidence of imperfect drainage of sub-soil or of foundation defects due to other conditions were carefully noted by survey stations. We have observed that

VIEW OF BITUMINOUS CONCRETE SURFACE REPLACING NARROW, WORN OUT MACADAM ON THE PUTNAM PIKE IN RHODE ISLAND.

it is rather dangerous to design foundations and plan sub-soil drainage from a single observation because of the fact that as a rule all of the spots which demand remedying may not show the need for special treatment simultaneously. Upon northern slopes or through a thickly wooded section the frost in the ground is slower in thawing than is the case upon southern slopes fully exposed to the sun. The effect brought about by thawing is furthermore not in evidence at the same time in soils of differing character. The thaw during which the first observation was made was not complete and was followed by severe cold weather which made possible subsequent examinations during thaws. Three complete examinations of sub-soil conditions were made, the first two of these having been made during thaws and the third having been made soon after the frost was completely out of the ground and the ground well saturated with water.

*Soil Conditions*

The observations from which treatment of foundation defects were planned showed that the soil conditions varied extremely. There were long stretches which showed that the soil conditions varied extremely. There were long stretches which showed not the slightest evidence of unstable sub-soil at any time. There were numerous stretches from 25 to 100 ft. long which became very soft and which rutted so deeply that traffic was endangered. A number of sections from 500 ft. to 3,000 ft. in length which were next to impassable even for light motor vehicles also were noticed. Careful notes of conditions taken when observations were carried out and a number of test holes dug later in order to make examinations of sub-soils furnished information which made possible an intelligent design of foundations and sub-soil drainage. It is apparent from the preceding description of conditions existing upon the old macadam that the adopting of a uniform cross section was not in order. Each individual defect in the old road was studied separately and taken care of in the manner which appeared to be the most feasible.

The occasional small soft spots in stretches which were otherwise free from foundation defects were found to be due to pockets of clay or of loam or to springs. Excavation of the clay or loam pockets and refilling with a coarse sandy gravel common in the vicinity was decided upon. Springs were drained to side ditches or to low points in fill.

Several relatively long stretches which were in abominable condition during thaws were upon the brows of hills from the beginning of cut on one slope to the running out of cut on the opposite slope. Ledges at the roadsides were in evidence in all of these locations. The difficulties experienced in these places were found to be due both to heavy retentive soils and to springs flowing from crevices in the ledges. As a rule, stone fill of wall and field stone laid to a V-section was laid to take care of these conditions. In excavating for these foundations bars of ledge extending almost to the bottom of the old macadam were uncovered. Our notes invariably recorded exceptionally distressing conditions immediately up-grade from these bars which of course constituted a barrier to the seepage of water in the sub-soil and which were responsible in consequence for heaving and rutting when the frost came out.

*Surface Treatment of Stone Fill Foundations*

The method of treatment of the surfaces of stone fill foundations in these locations is of interest. It was not deemed advisable to fill the voids in the foundation with sand or gravel, as is done frequently, because of the probability that the effectiveness of the foundations in taking care also of the flow of water from springs in the ledges would be impaired thereby. Our specifications called for grading of the sizes of stones employed for building the foundation, the smaller sizes being laid on the surface. This was not a difficult task, since the neighborhood abounds in field and wall stones of all sizes and also in chips from granite quarries. After the foundation was rolled until there was no further settlement, crushed stone passing a 1½ in. screen and retained upon a ½ in. screen was spread over the surface in quantity sufficient to fill the surface voids. Rolling was again carried out until the surface was well compacted. The object of this small crushed stone over the surface of the stone fill was to allow of more thorough compaction of the foundation than would have been possible without a filler of some sort and also to allow more free percolation of water through the foundation than would have resulted if a sand or gravel filler had been employed.

*Correcting Old Foundation Defects*

Very pronounced foundation defects were apparent upon the old road upon several grades which were nearly flat. Test pits dug upon these stretches disclosed the fact that loam existed a short distance below the surface of the road, although a thin layer of gravel was found under the macadam crust. The present layout of the road in large part is ancient and in the process of its development from an old trail to a graded earth road and later to a macadam all of the top soil was not removed to a sufficient depth below the surface. The fact that the grades were so flat where much of this trouble was experienced caused the flow of surface water to be retarded and induced complete saturation of the sub-soil. When thawing ensued, the results brought about by these conditions may readily be perceived. Excavation of all loam existing within 2 ft. of the surface, back-filling with clean sandy gravel and facilitating the flow of surface water by lowering of the flow lines of existing culverts so that the grades of side ditches could be increased were planned to take care of these difficulties. The obstacles to changes in the established grades of the road were so great

that such a course was not followed. In several locations where deep side ditches were not considered practicable in view of the impossibility of placing them far enough away from the metalled surface because of the narrowness of the right of way sub-drains were laid at the sides of the metalled surface in order to take care of sub-soil drainage. The placing of a number of culverts where none existed before also aided the drainage of surface water upon flat grades.

As has been stated previously, much of the old macadam evidenced no foundation defects. Examination of the sub-soil under the sections which were free from rutting or heaving in the early spring disclosed the fact that clean, coarse, sandy gravel which allowed of perfect sub-drainage was present in these locations. It was planned in these locations, therefore, to scarify the old macadam and to trench the area existing between the edges of the old macadam and the edges of the new metalled surface so that at least 6 ins. of new crushed stone might be added. New crushed stone was then spread to bring the surface up to the grade of the base of the wearing surface to be laid.

### *Culverts*

Practically all of the old culverts were replaced. These old culverts were largely of the stone box type which was the type employed almost universally by the local road authorities of Rhode Island before the days of state road building. Some of these culverts were in all probability built more than a century ago. The side walls were of dry masonry and the top slab was formed of large flat stones. We have found from experience that it is very dangerous practice to leave in these old stone box culverts when reconstruction is carried out. It might be supposed in view of the long service of many of these structures that they would last indefinitely, but the fact that the side walls frequently are laid without proper foundations and are of rather crude construction and also because the stone slabs are subject to breaking by frost action and by impact resulting from fast moving heavy loads makes their presence undesirable. The side walls of these culverts furthermore are so irregular that debris carried through the culverts lodges very readily and results in complete stoppage eventually. The recent increase in heavy motor trucking is doubtless responsible for the failure of many of these old stone box culverts which have endured for many years.

The foundation and drainage work planned to be done in connection with the reconstruction was described in detail in the typewritten instructions to the resident engineer in charge of the work. No feature of this important work was left to the judgment of the man who was to supervise the construction because many of the conditions which required remedying were not apparent at the season during which the construction work was to be done.

The types of wearing surface selected for reconstruction were bituminous macadam and bituminous concrete. The rebuilding of the portion of the road herein described was not completed in one year as was originally planned because of the impossibility of devoting to this line the funds which would have been involved under that plan. The first section rebuilt was in 1916 and the work was extended in 1917 and also in 1918.

### *Bituminous Macadam Wearing Surface*

The wearing surface laid in 1916 was bituminous macadam. The crushed stone employed upon this work was Connecticut Trap Rock and the binder employed was asphalt of approximately 10 mm. penetration. The crushed stone was laid invariably in two courses, the bottom course being sand-filled and laid to a grade 2½ ins. below and parallel to the finished surface. In both courses the crushed stone was of sizes passing a 2¼ in. ring and retained upon a 1½ in. ring. No bitumen was applied to the lower course of stone. The binder application of asphalt to the upper course of stone was followed immediately by an application of crushed stone passing a ¾ in. ring and retained upon a ½ in. ring. After a thorough rolling the seal coat was applied and immediately covered with clean ½ in. stone.

The crushed stone employed as a filler for the voids in the penetration course of stone was made relatively large so that the heavy seal-coat applied might penetrate between the individual stones with the result that a more perfect bond in the pavement might be secured than would have been the case if the sizes of stone employed for this purpose were so small as to result in the seal-coat forming a blanket over the surface. The character of the binder employed was such that cooling to a thick viscous consistency was so rapid as to prevent any appreciable penetration into stone of sizes much smaller than the sizes employed as a filler. The seal-coat was applied at the rate of approximately 1 gal. per square yard of surface, which is rather above the usual rate of application. The use of a relatively coarse filler, however, allowed of sufficient penetration of the bitumen into the small voids so that there has been not the slightest tendency toward softness of the surface in the hottest days of summer nor of waving under traffic. The bitumen was applied by a pressure distributor mounted upon a drum rather than upon wheels.

The work done in 1916 has given excellent service. There has been no evidence of foundation troubles which were so prevalent upon the old macadam. The process of surfacing was slow, although no bad results were experienced from this characteristic. The allowing of the seal-coat to penetrate into the void filler is considered to be responsible for the slow surfacing to a smooth typical asphalt surface. It was not until late in the summer of 1918 that this surface developed completely. The surface is still slightly mosaic, but few of the large stones are visible, the mosaic effect being produced by the visible surfaces of ¾ in. and ½ in. stone.

The work undertaken in 1917 was similar in character to the work done in 1916. The only difference worthy of note was the employment upon the section built in that year of crushed diabase obtained locally instead of imported crushed basalt. The results obtained in 1917 compared favorably with the results secured in 1916. The completion of the work carried out in 1917, however, extended late into the fall. Freezing weather was experienced before the work was completed and several light snow storms occurred. Upon the portion done last, light maintenance was required the following spring, but upon the whole this work was less than was anticipated in view of the conditions surrounding the construction.

### *Bituminous Macadam Wearing Surface*

The wearing surface laid upon the section rebuilt in 1918 was bituminous concrete. The rock available in the vicinity of this section was not deemed suitable for use in the wearing surface and imported stone was not considered because of the desire to curtail rail shipments in conformity with recommendations of Federal authorities and also because of the long haul involved from the nearest railroad station. The local rock was employed for the crushed stone base, for which use it was deemed adequate. The mineral aggregate employed for the bituminous concrete surface consisted of local sand and gravel screened and combined to conform in grading of sizes to the "Topeka" specification. There was nothing of special interest in the manner of mixing and laying of the wearing surface.

Our reconstruction is not wholly confined to the types of surfaces employed upon the work here described. The rebuilding of a portion of this line is characteristic, however, of the work which we are doing upon other roads in the nature of the problems to be solved and in the manner of working out the details of the methods to be employed in making the reconstructed roads serviceable at all seasons for all types of vehicles.

## Paving and High Prices

*Editorial from Urbana, Illinois, Daily Courier, Jan. 14, 1919*

The average citizen of Urbana would agree without much argument that it would be a splendid step forward for this community to lay some four or five miles of pavement this year. There are a half dozen streets that ought to be paved which are now unimproved, and there are as many more which have been paved in years gone by, but whose present condition is a reflection on the progressive spirit of the community, as well as a continuing annoyance to those who have to make use of them.

These facts are generally admitted, but when it comes to concrete proposals to remedy the situation, the first barrier raised is that of excessive cost.

Paving does cost more than before the war. It costs a great deal more. Some claim twice as much.

This, in itself, is not as great an objection as some people would have you think. Costs, after all, are relative. When paving prices are low, the prices of other commodities are also low, and those of us who make our living by disposing of the commodities we produce or the services we have for sale, are in no better position, relatively, to buy paving when prices are low than when prices are high.

When prices are high, as at present, money is plentiful, and practically everyone has work at profitable prices. Altho living expenses are high, it is possible to pick and choose what we shall buy, and it is feasible so to conduct our personal affairs as to have a surplus, if we make up our mind to it.

When prices are low, employment is uncertain, irregular, and for some, impossible to obtain. Money circulates less freely and most of us are afraid to spend a nickel for fear we will never get another.

If we wait for prices to go down before we start to pave, we will be in no position to pave when the condition demanded is attained. It is much more of a hardship on a community to thrust an ambitious scheme of public improvement on its property owners in the face of stagnation and panicky conditions, than it is when conditions are what they are today, with money circulating freely, with every one employed, and with no one feeling the pinch of hunger or privation.

The way to maintain good times and flush conditions is to keep business going. We must keep the dollar turning over, and over, and over. We make money, in a business sense, by spending it, not by saving it. Saving has its uses, and its virtues are indisputable, but there is a time to save and a time to spend. Stagnation is not prosperity. It is business death.

We should not be alarmed because our dollar will not buy as much paving as it used to do; neither are we justified in waiting to start such enterprise, for the day when the dollar will buy as much as it did in 1893, or even 1915. Those days may come again—which God forbid—but when they do, we will be far less able as a community to undertake the expense of public improvements than we are today.

We are through with the war; we are entering the channels of peace; the road to prosperity lies invitingly ahead of him who will seize his opportunity in time. Action is demanded. We should not remain asleep at the switch, nor let the rising sun of a renewed prosperity find our train hopelessly blocked on a side track while the rails on the main line rust from disuse.

Urbana's watchword this year should be "Full speed ahead."

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## Why Returning Yanks Will Boost Good Roads

Maj. D. D. Guilfoil, commanding the First Battalion of the 108th Engineers, in writing from Echternach, Luxembourg, to J. A. Sauerman, of Sauerman Bros., Chicago, tells why the returning American soldiers will be good roads boosters. He writes:

"I sure would have liked to have been in Chicago during that Good Roads Convention. If there is one thing I can talk about now it is good roads. Also, I have quite a flow of language concerning bad roads and no roads at all, having encountered both over here.

"That Illinois bond issue sounds good to me. Really believe that you will find an increase in the demands for more road improvements when the army gets back, for there is not a man over here who has not experienced personally the benefits of good roads and the discomforts of bad ones. What is more, it has been brought home to them in such a way that the war side of it will be entirely removed and they will want the good roads purely from an economic view.

"I have built roads out of every conceivable material. There is one little ruined French village that once had a fine large church. This church, together with all the other buildings, had been more or less shot to pieces. Mostly more. Today you will find the church and several other buildings are the component parts of a very fine road that I built through that section when our troops advanced. Many and many a time have I thanked whoever is to blame for the fact that nearly all the villages are built of stone. When we arrived at that spot the road had entirely disappeared; shell holes and road mines, for 1 kilometer, and the boche had flooded the section with 18 ins. of water. Three hours after we put over the first horse transport, and seven hours after we put over a train of 65 motor trucks. You see, we couldn't wait for material to come up from the rear."

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## How the City of Quincy, Illinois, Purchased a $1,000,000 Water Works Plant with $380,000

*By W. R. Gelston, Superintendent of Water Works, Quincy, Ill.*

The first water works plant at Quincy, Illinois, was built and owned by the city. Municipal ownership did not prove satisfactory and in the year 1873, the plant was sold to private parties. The city gave the new owners a 30 year franchise but reserved, to the city, the right to repurchase the plant at the expiration of the 30 years by a clause in the contract reading as follows: "At the expiration of 30 years from date of this ordinance, if no agreement can be made for renewal or continuance of contract, said city shall pay for such works, their then actual cash value."

### *Much Friction Develops*

Much dissatisfaction soon arose concerning water rates and there was a continuous conflict between the owners and the city. In the year 1890 and again in the year 1894, the city council declared that the construction of a municipal water works plant would be the only solution of the existing differences.

In the year 1895, the city council passed an ordinance providing for the establishment of a water works sinking fund and for placing in this fund, at the end of each fiscal year, any funds remaining in the appropriations for the various city departments.

About $12,000 were placed in this sinking fund as soon as the ordinance was adopted. In August, 1903, when the 30 year water works franchise expired, the sinking fund amounted to approximately $250,000.

### *Appraisal*

Just before the expiration of the contract, the city council secured the services of Messrs. John Alvord, Daniel W. Mead and Hiram Phillips for the purpose of making an appraisal of the water works property. These engineers fixed the value of the plant at the date of the expiration of the franchise, at $649,159.

The city did not have sufficient money to buy the plant and it was already in debt beyond the constitutional limit and could not borrow money with which to purchase the works. An attempt was therefore made to arrange a new contract with the owners. The owners refused to accept anything other than

a 20 or 30 years' renewal of the old contract, with no change in rates. Finally they gave the city and its assigns a written option under which the works might be purchased at any time prior to October first, 1904, at the appraised valuation.

*New Company Incorporated.*

Certain Quincy bankers were then asked to finance a new water works corporation and with their assistance, the Citizens Water Works Company was incorporated. The company was capitalized at $100,000 and the balance of the necessary money was raised by the company by issuing 5 per cent. first mortgage bonds for $300,000 and 6½ per cent second mortgage bonds for $250,000. The city transferred its option to the company and the plant was purchased thereunder.

Although the city did not invest any money in this venture, the contract entered into with the water company gave to the city substantially all of the advantages which would have followed from immediate municipal ownership and eliminated practically all the evils which usually result from such ownership. The Citizens Water Works Company was, to all intents and purposes, merely a holding company which was organized to hold and operate the water plant for the city until the financial condition of the city would permit the purchase of the property.

By the terms of the contract, the city was given the right to purchase the plant, at any time, together with all extensions and improvements made by the company for the sum necessary to enable the company to pay back to its stockholders the $100,000 which they had invested in the enterprise, and to pay the indebtedness of the company then outstanding. Since no increase was ever made in the amount of capital stock, or bonded indebtedness, the city had the right to buy the plant, at any time, at the appraised valuation of $649,159, regardless of any increased value due to extensions or betterments made and paid for out of the earnings of the plant.

*Contract Provisions*

The contract provided for the payment of 6 per cent. dividends, to the stockholders on the capital stock (and no more), and for the payment of the interest on the bonded indebtedness, from the earnings of the plant. The city guaranteed the payment of the dividends and interest so the stockholders and owners of the bonds had good safe investments. After the payment of the dividends and interest, the city was entitled to receive all of the benefits of the net earnings.

The company was permitted to use the net earnings in making extensions of the distribution system which would, at the outset, reasonably promise a return of 4 per cent. on the investment. With the consent of the city council, extensions could also be made where large feeder mains were needed but where the required annual revenue could not be secured. Extensive changes or improvements in pumping station or purification equipment could only be made with the consent of the city council.

The company was also allowed to lay aside, from the net earnings, an emergency fund of not to exceed $25,000, which had to be kept at interest at current savings bank rates.

The city reserved the right to change the water rates if the plant earned more than seemed to be necessary and the city had the right to order any surplus money to be used in paying off bonds of the company.

The management of the water plant was placed in charge of a Board of Directors, consisting of three members, one appointed by the city council and two elected by the stockholders of the company.

The company was obliged to make an annual financial report of receipts and expenditures to the city council and the city could have an audit of the company books made at any time.

*Unique Feature of Contract*

The unique feature of this contract with the company was the arrangement by which the city was enabled to increase the interest rate on its water works sinking fund. As previously stated, the water works sinking fund amounted to $250,000, when the water company was organized. The city had no legal power to purchase stock of the company with this fund and it could not invest it in the bonds of the company. The city could only order the city treasurer to deposit the fund in some bank duly incorporated under the laws of the United States or of the State of Illinois. The company, however, agreed to sell the bonds to such banks as might be designated by the city. This enabled the city to go to the banks and propose that it would deposit its $250,000 water works sinking fund with them and thus enable them to purchase the second mortgage bonds of the company, in the sum of $250,000, and that it would designate them as the parties to whom the bonds must be sold, provided the banks would agree to pay 5 per cent. compound interest on the water works sinking fund. Three Quincy banks accepted this proposition and the sinking fund was divided among them. Since the second mortgage bonds were made to draw 6½ per cent. interest, this arrangement allowed to the banks a net profit of about 1 per cent. on the sinking fund after making allowance for the 15 per cent. reserve fund which the banks were required by law to hold in cash in their vaults.

Then the first mortgage bonds, in the sum of $300,000, were made to mature in annual installments, each installment so maturing being made equal, as nearly as practicable, to the amount of the interest which the city would receive, in such year, on its water works sinking fund. Then there was inserted in the second mortgage a provision that there should be issued thereunder, additional bonds aggregating $300,000 (which was the amount of first mortgage bonds issued) and that these additional bonds should bear 6 per cent. interest and should be issued from year to year in sums equal to the maturing first mortgage bonds for such year and should be sold for the purpose of taking up and cancelling such maturing first mortgage bonds. The city deposited in the three banks, each year, the interest it received on its sinking fund and the banks then purchased the new second mortgage bonds.

*Financing Plan*

Table I shows the plan by which the first mortgage bonds were to be cancelled from year to year and how the amount of second mortgage bonds outstanding increased each year as the water works sinking fund increased. According to this plan, all of the first mortgage bonds would be replaced by second mortgage bonds on Oct. 1, 1920. On that date, the second mortgage bonds would aggregate $550,000 and the water works sinking fund would amount to the same sum and be suf-

TABLE I—PLAN FOR PAYING OFF FIRST MORTGAGE BONDS BY ISSUING NEW SECOND MORTGAGE BONDS IN EQUAL AMOUNTS.

| Date | Amount of first mortgage bonds maturing | Interest city will receive on its W. Sink. fund | Total amount of second mortgage bonds | Total Amt. of city's water works sinking fund drawing 5% compound interest |
|---|---|---|---|---|
| October 1, 1904..... | ..... | ..... | $250,000 | $250,000 |
| October 1, 1905..... | $ 12,500 | $ 12,500 | 262,500 | 262,500 |
| October 1, 1906..... | 13,000 | 13,125 | 275,500 | 275,500 |
| October 1, 1907..... | 14,000 | 13,775 | 289,500 | 289,500 |
| October 1, 1908..... | 14,500 | 14,475 | 304,000 | 304,000 |
| October 1, 1909..... | 15,500 | 15,200 | 319,500 | 319,500 |
| October 1, 1910..... | 16,000 | 15,975 | 335,500 | 335,500 |
| October 1, 1911..... | 17,000 | 16,775 | 352,500 | 352,500 |
| October 1, 1912..... | 17,500 | 17,625 | 370,000 | 370,000 |
| October 1, 1913..... | 18,500 | 18,500 | 388,500 | 388,500 |
| October 1, 1914..... | 19,500 | 19,425 | 408,000 | 408,000 |
| October 1, 1915..... | 20,500 | 20,400 | 428,500 | 428,500 |
| October 1, 1916..... | 21,500 | 21,425 | 450,000 | 450,000 |
| October 1, 1917..... | 22,500 | 22,500 | 472,500 | 472,500 |
| October 1, 1918..... | 23,500 | 23,625 | 496,000 | 496,000 |
| October 1, 1919..... | 25,000 | 24,800 | 521,000 | 521,000 |
| October 1, 1920..... | 29,000 | 26,050 | 550,000 | 550,000 |
| Totals..... | $300,000 | $296,175 | | |

ficient to pay off all of the bonded indebtedness on the plant, leaving only the capital stock of the company to be purchased, in order to assume complete ownership of the plant.

The Citizens Water Works Company took possession of the property on October first, 1904 and first mortgage bonds were paid off and cancelled and new second mortgage bonds were issued and sold to replace the maturing first mortgage bonds just as planned and indicated on this tabulation until Oct. 1, 1916.

In the meantime the city had paid off most of its indebtedness and could assume new obligations of sufficient size to provide the balance needed for the purchase of the property. As soon as this condition existed, the purchase of the water works became a political issue. The proposal to purchase the plant was finally submitted to the voters at the regular city election in April, 1916, and carried by a large majority. The transfer to the city was made on Oct. 1, 1916.

The city paid for the plant, as provided by the contract, the sum of $649,158 which was the appraised valuation on Oct. 1, 1904, and in addition thereto, the premium which was required to be paid on all unmatured first mortgage bonds, amounting to $1,137.35, making a total of $650,296.35.

In making this payment, the city used all of its water works sinking fund, a new water works bond issue of $130,000 and made up the balance from the earnings of the plant which were required by the contract to be turned over to the city with the plant.

The new bond issue of $130,000 is being paid off from the earnings of the plant at the rate of $26,000 per year and on July 1, 1921, they will all be cancelled and the city will own its water works plant free of all incumbrances.

During the twelve years the plant was operated by the Citizens Water Works Company, no changes were made in water rates. The first year the company controlled the plant, the gross earnings were $93,157 and they increased to a maximum of $133,000 per year.

*Extent of Works*

On Oct. 1, 1904, there were 46 miles of mains, 314 fire hydrants, 3933 services and 1996 meters in use. When the city purchased the plant, on Oct. 1, 1916, there were 75 miles of mains, 432 fire hydrants, 6540 services and 4516 meters in use. All of these additions were paid for from the earnings of the plant.

The Citizens Water Works Company also, with the consent of the city council, scrapped the old pumping station and filter plant and built and equipped a new pumping station and a modern concrete filter plant, including sedimentation basins. A new 36 in. cast iron intake pipe, 1,850 ft. long was laid in the Mississippi River. These improvements were also paid for from the earnings and cost approximately $200,000.

After the city purchased the property, Messrs. Alvord and Burdick made a new appraisement of the plant. They fixed the value of the property, on Oct. 1, 1916, at $1,070,000. The city paid $650,296.35 for it.

Mr. Theodore B. Pape, who was Corporation Counsel for the city in the years 1903 and 1904 worked out the details of the contract with the Citizens Water Works Company, and served as a member of the Board of Directors of the Company throughout its existence and to him should be given the credit for any merit which may be found in this unique method of attaining municipal ownership.

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## Some Features of Highway Work in Kansas

*By M. W. Watson, Acting State Highway Engineer, Kansas Highway Commission, Topeka, Kans.*

The 1917 legislature of Kansas created a State Highway Commission composed of the Governor, as ex-officio chairman, and two commissioners, one to reside east of the 6th Principal Meridian and one west of it.

Shortly after the passage of this act, the Commission met and appointed a State Highway Engineer, a Secretary for the Commission and various other employees. The present organization places the supervision of the road and bridge work in complete charge of the State Highway Engineer, who is assisted in their respective fields by the road engineer and the bridge engineer.

*County Engineers*

Each county is required to have a county engineer, whose appointment is subject to approval by the State Highway Commission and who serves for a term of two years. The engineer

VIEWS ON FEDERAL AID PROJECT NO. 12 IN GEARY COUNTY, KANSAS.

Mixing and Placing Concrete for Base of Brick Pavement—Laying Monolithic Brick Pavement, Showing the Parish Template in Operation—Grouting the Brick.

in addition to being an employee of the county, is in many respects a representative of the State Highway Commission in that county.

The Commission prepares standard plans and specifications for all road and bridge work. The plans for each individual bridge on a county road and each bridge the estimated cost of which is $2,000 or over on a township road, when constructed by the county, must be approved by the State Highway Engineer.

All Federal aid road work is under the direct supervision of the State Highway Engineer.

The Constitution of Kansas prohibits the state from engaging in any internal improvement and the Supreme Court has interpreted this clause as applying to road work, which makes it impossible for the state to have a fund for the construction of roads. The Federal aid fund is, therefore, furnished by the counties to be expended under state supervision.

*Benefit Districts*

The Kansas law provides that when any number of persons living in the vicinity of a road may so desire, they can form what is called a "benefit district" and petition the board of county commissioners to improve any laid out public road. The petition must contain the signatures of 51% of the resident land owners owning at least 35% of the land within the district or 35% of the resident land owners owing 51% of the land within the district, or the owners of 60% of the land within the district. By "resident land owners" the law specifies that they must live in the county and own land in the benefit district. When the last of the three alternatives applies, the signature of any land owner, regardless of where he resides, becomes effective on the petition. The petition is than presented to the board of county commissioners and if they deem the road of public utility, they declare it so by an order of the board and direct the county engineer, or some other competent highway engineer to prepare the plans for its improvement.

The petition must specify the definite location of the road by the place of beginning, the place of ending and other fixed locations, also the type and width of roadway desired, which may be different for different sections of road, and the number of annual assessments to be levied upon the land in the district, with the definite outlines of the boundaries and the land included in the district. The annual assessments can extend for not less than 10 years nor more than 20 years.

Any property owner in the district may pay his portion of the assessment in cash or can allow it to be paid annually for the period of the assessments. The board has a right to issue bonds covering the outstanding indebtedness on the work. After the work is completed and all Federal aid or donations have been deducted, the county pays 50% of the cost, the township 25% and the land within the district 25%, according to the benefit accruing to each piece of land.

*Federal Aid Roads*

The State Highway Commission has decided to give 15% Federal aid on any piece of construction which is located on the designated connecting system of Federal aid roads. This system of roads comprises about 3,500 miles and connects the principal cities throughout the state and covers the main through traveled highways. The Commission does not allow Federal aid on disconnected sections of roads.

Shortly after the formation of the Commission, war was declared and the difficulty in obtaining materials and labor has greatly retarded the progress of any hard surfaced road construction in the state. However, the Commission has been continuing to receive and approve petitions for road construction with the idea in view of getting ready for work after the war.

*Federal Aid Allottments*

Kansas has been allotted by the Government the following sums:

For the year ending June 30, 1917..... $143,207.40, available June 30, 1920
For the year ending June 30, 1918..... 286,414.80, available June 30, 1920
For the year ending June 30, 1919..... 429,622.20, available June 30, 1921
For the year ending June 30, 1920..... 572,829.60, available June 30, 1922
For the year ending June 30, 1921..... 716,037.00, available June 30, 1923

Total amount available.....$2,148,111.00, during 5 year period.

Applications for Federal aid have been made to the Commission for 28 sections of road, all of which have received the Commission's approval. 19 sections have been submitted to the Office of Public Roads, of which 15 sections have been approved, 2 rejected and 2 have not yet been considered by the Government.

*List of Approved Federal Aid Projects*

The following is a list of Federal aid projects which have been received and approved by the State Highway Commission, with the width and length of each:

| County | Name of Road | Proj. No. | Type | Width Feet | Length Miles |
|---|---|---|---|---|---|
| Barton, | Santa Fe Trail | 3 | Brick | 20 | 27.50 |
| Bourbon, | Ft. Scott-Pittsburg | 6 | W. B. Macadam | 14 | 6.39 |
| Bourbon, | Jefferson Hwy., North | 5 | W. B. Macadam | 14 | 8.70 |
| Bourbon, | Jefferson Hwy., South | 9 | W. B. Macadam | 14 | 11.71 |
| Bourbon, | Ft. Scott-Wichita | 8 | W. B. Macadam | 14 | 8.00 |
| Cloud, | Clasco Simpson | | Concrete | 16 | 8.25 |
| Douglas, | Fort to Fort Hwy. | 7 | Concrete | 18 | 18.34 |
| Finney, | Santa Fe Trail | | Brick | 20 | 28.00 |
| Ford, | Santa Fe Trail | 14 | Brick | 20 | 11.00 |
| Geary, | Golden Belt, W. of Junction City | 10 | Concrete | 18 | 7.55 |
| Labette, | 32d St., Ozark Trail, King of Trails | 2 | Gravel | 16 | 44.50 |
| L'venworth, | Fort to Fort Hwy. | 13 | Concrete | 18 | 22.00 |
| Mitchell, | Beloit-Asherville | 1 | Concrete | 16 | 11.25 |
| Reno, | New Santa Fe Trail | 15 | Brick | 18 | 17.7 |
| Sedgwick, | Central Avenue | 11 | Concrete | 18 | 7.375 |
| Shawnee, | Lawrence & Topeka State Road | 4 | Concrete | 18 | 10.00 |
| Rice, | New Santa Fe Trail | | Brk. or Conc. | 18 | 2.31 |
| Geary, | Golden Belt east of Junction City | 12 | Brick | 20 | 1.12 |
| Rice, | New Santa Fe Trail | 16 | Brk. or Conc. | 18 | 3.00 |
| Rice, | Old Santa Fe Trail | | Brk. or Conc. | 18 | 5.00 |
| Sedgwick, | Lawrence Ave., Meridian Trail | | Brick | 20 | 12.50 |
| Allen, | State Street Road | 19 | Grav. or W. B. Mac. & Resurf. | 16 | 4.25 |
| Allen, | Iola-Moran Road | 18 | Concrete | 18 | 1.00 |
| Douglas, | Old Santa Fe Trail | | Concrete | 16 | 23.25 |
| Geary, | Golden Belt Road | 17 | Brick | 20 | 0.90 |
| Reno, | S. Fe Tr. Cut Off & Santa Fe Tr. No. 2 Road | | Brick | 18 | 35.00 |
| Johnson, | Santa Fe Trail | | Recon. Bit. Mac. | 18 | 6.00 |
| Allen, | Humboldt-Chanute Road | | W. B. Mac. or Grav. & Conc. | 20 | 3.25 |

Rejected by Federal Government.

The total estimated cost of this work is approximately $8,076,760.12.

The Federal aid which will be received according to allotment is approximately $1,219,975.23.

*Project No. 12 in Geary County*

Project No. 12 in Geary County has been awarded at a contract price of $41,182.80 to M. R. Amerman, of Salina, Kansas. The earth work contract on this section, which is not a part of the project, was awarded for $2,870.32. The culvert work contract was awarded for $1,020. No Federal aid was received on earth work or culverts.

This road is of considerable military importance, connecting the city of Junction City with the military cantonment at Fort Riley and Camp Funston, Kansas.

From a traffic census taken by Government engineers, it is estimated that there will be about 8,000 vehicles per day on the road after completion.

*Monolithic Brick Chosen*

The contract was awarded on July 24, 1918, and the work started during the week of August 5, 1918. The work was advertised to receive bids on two different plans. One was for a concrete pavement throughout, the other for a monolithic brick road from Station 0+10.8 to Station 57 and a reinforced concrete road from State 57 to Station 59+14. The latter plan was selected by the board after the bids were read.

The monolithic brick road is composed of a wearing surface of 3 in. vertical fiber brick with cement grout filler and has a base 3 ins. thick on the sides and 4½ ins. thick in the center, using a 1:3:5 mixture of concrete. The reinforced concrete section is of the two course type and reinforced with 45 lbs. of mesh reinforcement to each 100 sq. ft. of pavement.

*Much Road Work Coming*

Before many months at the present rate of progress, there will be filed with the State Highway Commission applications

for road work to the value of about $14,000,000, and although ranking as one of the last in the matter of hard surfaced roads constructed, Kansas will soon rank well up among the first. There are about 111,000 miles of public highways in Kansas, of which only about 1.3% have been improved by any type of surfacing and of this amount about 0.7% is of sand-clay.

The Honorable Arthur Capper, Governor, is chairman ex-officio of the State Highway Commission and Mr. R. S. Tiernan, of Fort Scott, and Mr. E. R. Moses, of Great Bend, are the members.

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## Design and Performance of the Iron Removal Plant for Laundry Water at State School, Sparta, Wis.

*By W. G. Kirchoffer, Sanitary and Hydraulic Engineer, 22 N. Carroll St., Madison, Wis.*

The State School for Dependent Children, located at Sparta, Wisconsin, has three sources of water supply: the city water for general purposes, that from flowing deep wells for drinking fountains, and that from shallow driven wells, which, until recently, has been used for laundry purposes.

### *Iron and Manganese*

All of these waters carry considerable quantities of iron in solution and the city water has at times a slight amount of manganese. The deep well water is the most highly charged of them all.

The following determinations in parts per million, on these waters were made in the State Laboratory of Hygiene.

| | *City Water* | *Deep Wells* | *Driven Wells* |
|---|---|---|---|
| Total Solids | 108.0 | | |
| Chlorine | 3.00 | | |
| Hardness | | 97 | 60 |
| Alkalinity | 80.0 | 75 | 25 |
| Iron (average) | 2.58 | 3.19 | |
| Manganese | 0.1 | 0 | |

### *Geological Conditions*

Sparta lies in the valley of the La Crosse river which is carved deep in the Potsdam sandstone. The surface material about Sparta is largely sand derived from the disintegration of this rock. The surface of the rock formation is reached at varying depths but in the vicinity of the city water works and state school it is at about 100 feet. Ground water is found in the sand formation at a depth of from 10 to 20 feet, depending on the elevation of the ground above the bottom of the valley. At depths of 187 feet and 297 feet, underneath hard flinty layers of rock, are found sources of water that will flow at the surface.

There are many of these flowing wells about Sparta, but all are highly charged with hydrogen sulphide and iron. The city supply was formerly from the shallow ground water supply, but is now a mixture from a deep well and the old ground water supply. The water for the drinking fountains at the state school is also from one of these deep wells.

Some years ago in an effort to get a supply for laundry use that would be reasonably free from iron the shallow driven wells were put down. These have never been entirely satisfactory as the water contains some iron and the points clog up and have to be replaced frequently. It was suggested by a former superintendent of the school, that a supply of rainwater might be obtained from the roofs of the various buildings of the school by collecting it in cisterns. A detailed investigation of this scheme revealed the fact that it would require the rains of five months to produce enough to last the laundry only two weeks.

### *Experimental Plant.*

At about this time the writer was investigating methods of removing the iron from available sources of water supply for the city. A joint investigation of the deep well water at the state school was made for the city and school. A small experimental plant consisting of three ordinary oil barrels was used for this purpose. The first two were filled with new coke broken up to about a 2 in. size and in the third barrel a sand filter was constructed. All of the sand and gravel was thoroughly washed for the purpose of removing all foreign matter and extremely fine sand such as would pass sieves 80 to 100 to the inch.

The well water was discharged onto the coke in the first barrel through a circular lawn sprinkling nozzle, then it passed down through the coke to a connection between the first and second barrels and then upward through the second barrel to the outlet connected to the third barrel in which the sand filter was placed. The outlet of the sand filter was at the bottom and was controlled by a valve. The rate of flow was about three-quarters of a gallon per minute. Samples of the raw water and effluents from the coke and sand filters were

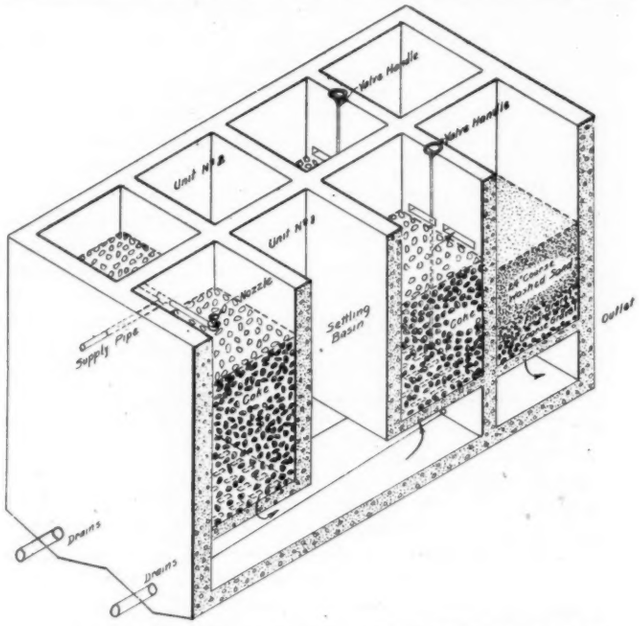


FIG. 1—ISOMETRIC VIEW OF IRON REMOVAL PLANT, STATE SCHOOL, SPARTA, WIS.

taken at frequent intervals. These were sent to the hygienic laboratory and analyzed for iron and manganese. No manganese was found.

### *Results of Analyses Satisfactory*

The results of these analyses are given in Table I and are shown graphically on Diagram 1. These results were so highly satisfactory that a report was made to the State Board of Control, the executive body in charge of the school, recommending the construction of a plant to treat 6,000 gallons of water per day. This plant was designed in the summer of 1918 and has just recently been put into operation. The treated water is stored in a concrete reservoir, 16 ft. in diameter by 10 ft. deep. The plant was designed to operate in exactly the same manner as the test plant was operated, except that it was built in duplicate and a settling tank was placed between the first and second coke contact filters. The settling chamber extended under the coke filter and was provided with a "V"-shaped bottom so as to draw off the deposit into the sewer when necessary. Valves were also provided to drain the water off from above and below the sand filters and for back washing them when necessary. The nozzles used were of the round Taylor type such as are used for sewage on sprinkling filters. The water from the flowing well has pressure enough to throw the water in a thin sheet but not into a spray.

Fig. 1 is an isometric view of the plant with the side wall removed, and Fig. 2 is a plan showing the location of the plant and connections to the well and reservoir. From the reservoir the treated water is raised by steam pumps to an elevated wood tank as it is needed.

### *The Sand Used*

The sand used in the filters was analyzed by a nest of standard sieves with the following results:

| | | |
|---|---|---|
| Held on 4 | 1.15 | per cent. |
| Held on 10 | 38.0 | per cent. |
| Held on 20 | 26.9 | per cent. |
| Held on 30 | 15.1 | per cent. |
| Held on 40 | 12.0 | per cent. |
| Held on 60 | 7.2 | per cent. |
| Held on 80 | .3 | per cent. |
| Held on 100 | .1 | per cent. |
| Pass 100 | .06 | per cent. |

### *Cost of Labor*

This plant was built by day labor under the direction of Mr. C. H. Phillips, superintendent of construction for the Board of Control. The cost of the plant, including a frame building covering it, was as follows:

| | |
|---|---|
| Superintendent of Construction | $293.55 |
| Foreman | 83.33 |
| Rock | 7.10 |
| Sand | 58.17 |
| Freight and express | 11.95 |
| Labor | 295.42 |
| Hauling stone and sand | 73.33 |
| Cement | 190.50 |
| Lumber | 168.17 |
| Stone | 110.00 |
| Labor | 12.00 |
| Miscellaneous materials | 159.54 |
| Two manhole covers | 11.00 |
| | $1,472.06 |

### *Operating Results*

After the plant had been in operation about two months, determinations of iron and hardness were made by the Hygenic Laboratory with the following results in parts per million:

| | Effluent from Coke filter | Effluent from Sand filter |
|---|---|---|
| Iron | 0.6 | 0 |
| Total hardness | 101.5 | 84.3 |

Not only was the iron completely removed by this treatment, but the hardness was reduced about 16%. This water is slightly harder than that from the driven wells, but if this hardness proves objectionable, the sand filters are built so that a layer of zeolite can be placed beneath the sand and thus produce a water of zero hardness.

### *Extracts From Specifications*

Construction—The reservoir is to be constructed of reinforced concrete, including side walls, bottom and cover. The side walls are to be 12 ins. thick and are to be reinforced with ½ in. horizontal circular rods 2 ins. from outside face and with 18 vertical rods spaced 4 ft. 6 ins. c.c. The bottom of the reservoir will be 9 ins. or more thick, depending upon the level

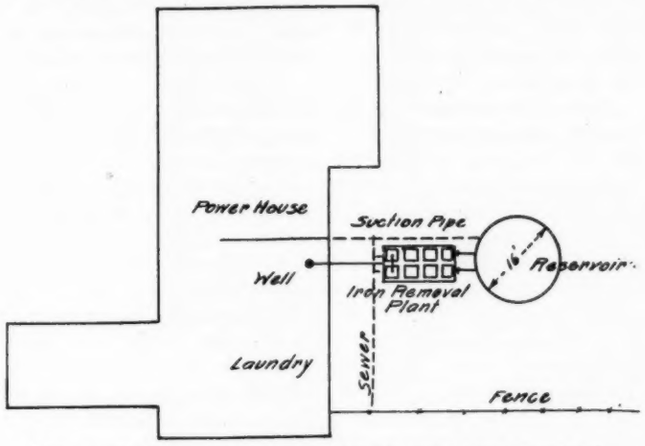


FIG. 2—PLAN OF LOCATION OF PLANT AND CONNECTIONS TO WELL AND RESERVOIR.

of the materials when the excavation is completed. The bottom of the reservoir will be reinforced with ½ in. rods, radial and circular rods, and placed 2 ins. from the surfaces of the concrete.

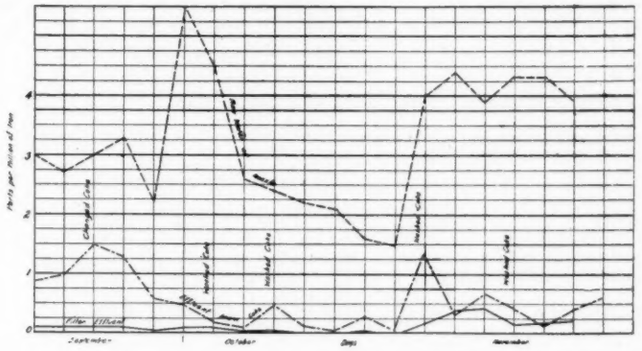

DIAGRAM 1, SHOWING RESULTS OF OPERATION OF EXPERIMENTAL IRON REMOVAL PLANT.

The iron removal plant walls and bottom will be constructed of reinforced concrete 6 ins. thick, except the filter bottoms, which will be 3 ins. thick.

Size and Shape—The reservoir is to be circular in form, 24 ft. inside diameter and side walls 10 ft. high above the bottom of the reservoir next to the walls. The side walls on both sides are to be vertical. The bottom of the reservoir will have a

TABLE I—SHOWING THE REMOVAL OF IRON FROM DEEP WELL WATER AT THE STATE SCHOOL, SPARTA, WIS., BY AERATION, COKE AND TREATED SAND FILTER.

| Raw Water Sample No. | Kind of Filter | Iron in Raw Water | Effluent from coke filter | Amount removed by coke | % Removed by coke | Amt. in filtrate | Amount removed by sand | % Removed by sand |
|---|---|---|---|---|---|---|---|---|
| 7 | Aeration, coke and sand filters, 6 lbs. per min. | 3.0 | 1.5 | 1.5 | 50 | 0.1 | 1.4 | 93 |
| 10 | Aeration, coke and sand filters, 6 lbs. per min. | 3.3 | 1.3 | 2.0 | 60 | 0.1 | 1.2 | 92 |
| 13 | Aeration, coke and sand filters, 6 lbs. per min. | 2.2 | 0.6 | 1.6 | 73 | 0.05 | 0.55 | 91½ |
| 16 | Aeration, coke and sand filters, 6 lbs. per min. | 5.5 | 0.5 | 5.0 | 91 | 0.1 | 0.4 | 80 |
| 19 | Aeration, coke and sand filters, 6 lbs. per min. | 4.5 | 0.2 | 4.3 | 95½ | 0.1 | 0.1 | 50 |
| 22 | Aeration, coke and sand filters, 6 lbs. per min. | 2.6 | 0.1 | 2.5 | 96 | 0.05 | 0.05 | 50 |
| 25 | Aeration, coke and sand filters, 6 lbs. per min. | 2.4 | 0.5* | 1.9 | 79 | 0.05 | 0.45 | 90 |
| 28 | Aeration, coke and sand filters, 6 lbs. per min. | 2.2 | 0.15 | 2.05 | 93 | 0.0 | 0.15 | 100 |
| 31 | Aeration, coke and sand filters, 6 lbs. per min. | 2.1 | 0.05 | 2.05 | 97½ | 0.0 | 0.05 | 100 |
| 34 | Aeration, coke and sand filters, 6 lbs. per min. | 1.6 | 0.3* | 1.3 | 81 | 0.05 | 0.25 | 83½ |
| 37 | Aeration, coke and sand filters, 6 lbs. per min. | 1.5 | 0.05 | 1.45 | 96½ | lost | ... | ..... |
| 40 | Aeration, coke and sand filters, 6 lbs. per min. | lost | 1.36* | ... | .... | 0.16 | 1.20 | 88 |
| 43 | Aeration, coke and sand filters, 6 lbs. per min. | 4.4 | 0.32 | 4.08 | 92½ | 0.4 | ... | ..... |
| 50 | Aeration, coke and sand filters, 6 lbs. per min. | 3.88 | 0.68 | 3.20 | 82½ | 0.44 | 0.24 | 35 |
| 53 | Aeration, coke and sand filters, 6 lbs. per min. | 4.32 | 0.44 | 3.88 | 90 | 0.16 | 0.28 | 64 |
| 56 | Aeration, coke and sand filters, 6 lbs. per min. | 4.32 | 0.12 | 4.20 | 97 | 0.2 | ... | ..... |
| 59 | Aeration, coke and sand filters, 6 lbs. per min. | 3.88 | 0.44 | 3.44 | 89 | 0.24 | 0.20 | 45½ |

*Back washed coke previous to this sample.

slope of 6 ins. towards the outer edge of the sump. The sump will be a depression in the bottom of the reservoir 3 ft. square and 1 ft. 6 ins. deep.

The iron removal plant will be rectangular in plan 7 ft. 6 ins. wide, outside, by 14 ft. 6 ins. long and will consist of concrete tanks 3 ft. square in which will be located the coke and sand filters.

Coke—The coke to be used in this plant should be clean foundry coke of medium size and in sufficient quantity to fill the coke filters to the levels given.

Sand and Gravel For Filters—The sand used for the filters should be a coarse clean sand of uniform size of sand grains. Before placing in the filters the sand should be screened through a ¼ in. mesh (3/16 mesh is better if obtainable) and then thoroughly washed on the surface of a sloping platform so as to remove all dirt, silt and fine sand grains. A quantity of sand 20% in excess of that at first required should be prepared so as to have some to replace that which is lost in scraping. The gravel should be assorted for two sizes, ¾ in. to 1½ in. and ¼ in. up to ¾ in. This should also be washed to remove silt, clay and sand.

Filter Bottoms—The bottoms of both the coke and sand filters should be made of reinforced concrete with tapering holes through them, these holes are to be made by placing blocks cut from 2x4 in. pieces on the surface of the forms at the proper locations. The forms for the sand filters must be cast separately and then placed after the forms are removed from the filter compartment. These should be cast ¼ in. smaller all around than the inside dimensions of the filter so that they can be placed readily. The bottoms for the coke filters should be poured at the same time as the side walls are poured and the reinforcing steel must be banded with that in the side walls. The pipes in which the valve rods are placed must be set before pouring the concrete.

Drain to Filters—The central and lower compartments of the plant will be connected with the sewer at two points. These drains will be controlled by shear gates located inside the plant and set in the north wall. The handles for these valves will have to be hinged so as to allow the handle to operate in a 1 in. pipe. The shear gates are of the McDonald Foundry Co., Columbus, O., type.

Drains to Sand Filter—For the purpose of draining each sand filter and to provide water for back washing them, there will be placed in the walls, between the coke filters and the sand filters a pipe and valve operated by long handle extending to top of filters. The pipe and valve should be 2 in., 2½ in. or 3 in. in diameter.

Wash Water Overflow—Each sand filter will be provided with a valve located near the top of sand to be used when back washing the sand filters. These should be 2, 2½ or 3 in. in diameter as may be desired.

Connections to Reservoir—Each filter will be connected to the reservoir with wrought iron pipe and valve of same size. The valve may be any type of valve or shut off, so made that it can be operated by a key from the top of the ground. The valve should be protected by pieces of 6-ft. vitrified pipe extending to surface.

Description of Plant—This plant is for the removal of iron from the deep well water which is to be used for laundry purposes. The process consists of spraying the water over coke, by means of a specially designed nozzle, in a thin film, thus aerating the water. It then flows downward through the first compartment of coke into a small settling reservoir, then upward through a second contact of coke to the sand filter, when it flows downward to the storage reservoir. The plant will be constructed in duplicate. The plan of operation will be to use one unit until the sand or coke or both becomes so clogged with iron that it will not pass 4 gals. per minute. Then the other unit will be put in use and the first one will be drained out to the sewer and the coke washed, if necessary, with a hose, and the sand filter back washed with water from the settling reservoir (between the coke filters). The least washing that can be done and still supply the necessary amount of water, the better will be the results. The exact amount of washing can best be told by experience.

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## Recommended Procedure in Cleaning Streets in Rochester, N. Y.

*By James W. Routh, Chief Engineer and John T. Child, Assistant Engineer, Rochester Bureau of Municipal Research, Inc.*

The present article comprises a brief, constructive criticism of the common methods of street cleaning with special reference to conditions in Rochester, N. Y. What follows is from the summary of a report on the problem of street cleaning in the city of Rochester, submitted to the mayor and the commissioner of public works by the Rochester Bureau of Municipal Research, Inc. The report, which contains a large amount of data and discussion on street cleaning has just been released.

### *Nature and Sources of Street Dirt*

Street refuse appears in two forms, as fragments of various sizes and as fine dust. It has been traced to a number of different sources, some of which are controllable while others are not. Among the sources of street dirt which can be regulated is the character of street pavements. Poor pavements are the source of much street dirt. For example, in Rochester it costs 53 per cent. more to clean Medina stone block pavements as constructed than it costs to clean asphalt pavements. Street cars are a source of much dirt, and the tracks interfere with effective cleaning, as well as being in themselves sources of dirt. Steps should be taken to require the street railway company properly to construct and maintain its tracks and track areas, so as to reduce as much as possible the amount of dirt from this source.

Other sources of street dirt which can be controlled to a great extent are the throwing of rubbish and litter in streets by the public, the deposition of soot and cinders from the careless burning of soft coal, and the placing of lawn rakings, bush clippings, etc., in the gutters of residential streets These things are largely a matter of public co-operation, and steps should be taken to obtain this co-operation, even to the extent of making the ordinances governing such actions penal ordinances, and insisting upon the co-operation of the police.

### *Sweeping Streets by Hand*

Sweeping streets by hand with push brooms is the oldest and most generally used method of street cleaning. The work is done mostly by patrol sweepers working singly. In Rochester this work is poorly and irregularly laid out and controlled. There appear to be no standards of cleanliness observed, and there are no standard work methods in use. The patrol sweepers' routes should be laid out scientifically and fairly in all sections of the city. Among the various factors influencing the size of these routes are the quantity of dirt deposited, the amount and character of traffic, and the kind and condition of pavements. These, as well as various other factors, should be taken into account in laying out this work.

The equipment used by patrol sweepers is, for the most part, satisfactory, although certain changes in sizes and types should prove of benefit. When standard work methods are established, a standardization of equipment also should be made. Apparently there is no uniform procedure in street sweeping observed in Rochester. Experiments conducted in some of the larger cities indicate general principles to be observed for this kind of work, and these principles should be observed in Rochester.

### *Street Flushing*

Water is the best means of removing from street pavements fine dirt and dust particles which cannot be removed by other means. It is necessary, however, to differentiate between

street sprinkling and flushing. Street sprinkling results merely in the temporary laying of the dust, whereas flushing, if properly done, washes dust and dirt from the pavement. Flushing is done by means of hose, motor flushers and horse-drawn flushers. Motor or machine flushing is perhaps the most satisfactory method of street cleaning. Two motor flushers are operated in Rochester, and analyses of the work done by them show fairly satisfactory results obtained. Certain improvements are possible, however, and performance tests conducted last summer indicate means for adjusting the equipment to obtain better results and to decrease the cost of the work. It is believed that one of the flushers might more economically be transformed into a motor truck for carting purposes, and that three or four additional flushers of high power and modified design should be purchased.

Performance tests and observance of practice last season, together with results of experiments conducted elsewhere, form the basis for suggested motor flushing procedure. Diagrams have been prepared to indicate advisable combinations of nozzles and flushing procedure according to different conditions to be met. These diagrams and this procedure are based on a working pressure of 40 pounds, which was not always obtained last year, owing to the fact that one of the flushers has not a sufficiently powerful engine for the work.

In addition to the suggested modification or standardization of procedure, it is evident that this work should be done under adequate supervision, which is not the case at present. Some of it can be done during the day on residential streets, but no the heavy traffic business streets flushing can be done only at night. This means that a night superintendent of street cleaning is necessary. Even with the best of equipment and most careful supervision, however, it is believed impossible to obtain desired results from motor flushing certain Medina block car track streets. Streets of this kind should be hose flushed until they are resurfaced with asphalt, as many of them should be.

Most of the wagon flushing done in Rochester is done with ordinary sprinkling wagons which cannot do satisfactory work. The city owns some pressure wagons, and when properly operated, fairly satisfactory results are obtained with this equipment. There is great irregularity in local practice of wagon flushing, however, due to lack of proper supervision and the fact that part of it is done by contract, with only superficial inspection. The use of sprinkling wagons for flushing should be discontinued, and in their place more pressure wagons, or, preferably, more motor equipment should be used.

For washing extremely dirty or rough pavements, hose flushing is the most satisfactory method. With hose the stream can be concentrated where needed, and the quantity of water used can be regulated by varying the sizes of the nozzles used. Local hose flushing practice is decidedly irregular and unsatisfactory. Comparatively poor results are obtained at unnecessarily high costs. This is due to a lack of knowledge of the proper method of doing this work and a lack of any standard practice and adequate supervision. The equipment used is not altogether satisfactory, and steps should be taken to make it conform to acknowledged standards when standard work methods are adopted for use.

### *Street Sprinkling*

The sprinkling of hard surfaced pavements is believed to be an absolute waste of water, unless it is done in conjunction with some cleaning operation, such as flushing, machine sweeping, or squeegeeing. Earth and macadam streets, however, require sprinkling to lay the dust, and consequently a certain amount of sprinkling probably will have to be done for some time to come. It is believed, however, that contract sprinkling results in a net loss to the city and in an unusually high profit statistics prove that during the sprinkling season about 40 to the contractors, because of the lax control exercised over the work and because of the large number of rainy days in Rochester during which sprinkling is unnecessary. Weather per cent. of the days have precipitation, which tends to reduce the amount of sprinkling necessary. The payment to the contractor, however, is not adjusted in accordance with the amount of work actually done. It is believed, therefore, that the sprinkling work should be done by the Department of Public Works. (Motor flushers could be used during the day for sprinkling. This would make more economical the operation of this expensive equipment).

Another reason for requiring the work to be done by the Department is that in this way sprinkling work can be coordinated with cleaning work, particularly with flushing and machine sweeping, in both of which sprinkling in advance of the cleaning process generally is of value. Not only should the sprinkling work be taken over by the Department, however, but a large portion of it should be dispensed with in favor of flushing.

### *Machine Sweeping*

Machine sweeping is done by large rotating brooms mounted on wagon frames and drawn by horses. This work is not satisfactorily done in Rochester. The equipment is mostly obsolete and no longer effective; the work is not planned in conjunction with other cleaning processes nor with sprinkling, and supervision over it is lax. The most apparent need for improved machine sweeping work is a fixed standard of practice, which would insure the greatest amount of work being done for the least expenditure of money. The cost during 1917 was unnecessarily high and not consistent in all parts of the city. In future machine sweeping work, standard practice is suggested for use. This entails more extensive use of equipment and better control over the work. It is believed also that the work should be extended to include the sweeping of certain of the heavy traffic and dirty streets in the business section of the city at night.

### *Special Street Cleaning Problems*

The problem of litter is one of the most interesting parts of the street cleaning problem. Litter is the most evident reason for dirty looking streets, and its removal is the source of much work and expense. It is believed that more rubbish cans should be supplied for use of the public, particularly in the business part of the city, and that better co-operation should obtain between the public and the Department in reducing the amount of litter deposited on the street. In addition to this, the litter patrol downtown should be extended as needed and the equipment used should be changed somewhat. The use of a burlap bag, with a spreader to keep the top open, and a stick with a steel point or hook for picking up paper will be found to reduce the fatigue of the laborers.

In addition to improving the quality of work done in picking up street litter, and in connection with it, it is believed that downtown sidewalks should be swept by the street cleaning force. This has been done in certain cities with marked success, and eliminates many of the difficulties which now exist in having the walks swept at the proper time so as to allow the sweepings to be collected together with the street dirt.

The leaf problem is an important one in Rochester, and it is believed that the use of machine sweepers and the enforcement of the ordinances, with some changes in them which would require property owners to gather up the leaves and to place them in burlap bags or barrels for collection, would help to reduce the work involved.

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## Method Employed in Resurfacing Old Macadam Streets in Madison, Wis.

*By George Sullivan, Superintendent of Streets, Madison, Wis.*

To resurface an old macadam street the entire surface should be scarified to a depth of about 3 ins. When this is done grade it with the street grader until it is perfectly level.

This result may be facilitated by using a few yards of crushed stone for filling. Then roll it down with the steam roller until it becomes firm or solid. In some cases it may be necessary to use a little screenings and some water in order to get the proper consistency. By all means give it a good thorough rolling. Then apply a good coat of hot tar with the distributor, and cover the tarviated surface with coarse sand or screenings, after which it should be given a thorough rolling. Put enough sand on the tar so that it will not stick to the roller, and after the street is rolled, it will be ready for travel, says Mr. Sullivan, writing in the January issue of The Municipality.

*Good Results Secured*

We, in the city of Madison, have had the best of results in treating old macadam roads in this manner. Some of the streets we have already repaired in this manner are from 15 to 25 years old, and when resurfaced in this way, are practically as good, and in some cases, better than they were when they were new.

In this kind of work, the city of Madison uses what is known as Tarvia A. We have found this Tarvia A very satisfactory as it seems to set up very quickly and permits travel immediately after it is applied. This Tarvia should always be put on hot.

*Repairing Holes*

For repairing holes in old macadam pavements we use Tarvia X. For this class of repair work we take an ordinary dump wagon with a division in the middle of the box. We fill one part of the box with crushed stone and the other part with screenings. We take a small iron kettle which holds about two barrels of Tarvia X, with a fireplace in it for heating the material. This kettle is fastened behind our repair wagon loaded with stone and screenings, and the outfit taken to the street to be repaired. With a pick we form a shoulder around the hole in the street to be repaired, and fill the hole up well flush with the pavement. Then with a tamping bar we tamp the stone down until it becomes even and solid and pour in enough of the hot Tarvia X to bind it together. This is then covered with coarse sand or screenings and then tamped down firmly. After this process the street is ready for travel. Patches put on in this manner very seldom give out.

*Applying the Tarvia*

In surfacing any kind of a macadam street with Tarvia A, the Tarvia should be applied hot, covered with sand or screenings immediately and rolled while the Tarvia A is soft and still hot, as in this way, the tar takes up most of the sand and forms a wearing surface of itself, and naturally proves a great saving to the macadam. It also helps to make rough and uneven pavements a great deal smoother and pleasanter to drive on.

One of the principal factors to be considered in tarviating any kind of a pavement is to have the pavement thoroughly clean and free from all dust, as the Tarvia will not adhere to dust.

We bought our Tarvia A at 8½ cts. per gallon, and our Tarvia X, at 11 cts. per gallon, which is a great deal cheaper than it can be purchased at the present time. We made our contracts last fall and in this way got last year's prices. Sand in Madison this year is very costly. It sells at $1.15 per ton at the bin, which makes it very expensive for covering. It takes on an average of about 428 gals. of Tarvia A to the block, and about 16 2/3 yds. of sand. The average block in Madison consists of about 1,760 sq. yds., which means about 1/3 gal. to the square yard.

## Precautions to Observe in Locating New Roads

The following precautions to be observed in locating new roads are suggested by A. Dennis Williams, Engineer-Chairman of the West Virginia State Road Commission:

1. Ground which has a tendency to slip should be avoided if possible.

2. The road, if on slope, should be placed where the dip of the strata leads the water from the road whenever conditions will permit.

3. Roads should be placed, when practical, on slopes which are exposed to the sun in the winter, so as to reduce the number of days the roads will be covered with ice.

4. Curvatures should be kept to the lowest degrees possible so that the longest obtainable sidelines may be had.

5. The roads should be located above high water when conditions will warrant.

6. The grades should be the best that topography will permit.

7. For horse-drawn vehicles, distances should yield to grade.

8. For motor vehicles, alignment and surface may take precedence over the grade, but grade must be considered.

9. Direction of the traffic and the kind of freight produced in the community should be considered.

10. The nature of the future development of the territory should also be noted.

11. The general bearing the improvement will have on the other sections of the state and nation, should be studied and applied to the general plan.

12. In short, everything to make the road of the greatest service at the lowest cost, should be done so far as possible and practicable.

## Recent Developments in Design and Construction of Pavements in Chicago

*By H. J. Fixmer, Paving Engineer, Board of Local Improvements, Chicago, Ill.*

During the year 1918 several changes in pavement design were adopted or improved and successfully realized in practice in Chicago.

*Crown*

To accommodate present and future vehicular traffic which is becoming entirely self propelled, more attention has been given to fitting the paving construction to the new traffic needs. A new form of crown line or surface contour has been adopted which is shown graphically in Fig. 1. Instead of the familiar parabola a flatter curve is used. In Fig. 1 the position of the new crown line with reference to a parabola having the same depth of gutter at the curb and an equivalent parabola passing through the shoulder or quarter point is plainly shown.

The advantages of the new form of crown curve may be outlined as follows: It increases the cross drainage near the middle of the roadway. It permits a reduction of total crown slope of at least 25%. It secures a more satisfactory surface

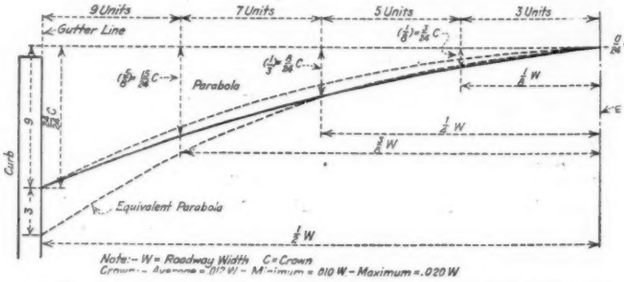


FIG. 1. NEW CROWN SECTION, CHICAGO PAVEMENTS.

from the standpoint of construction, drainage and use. The reduction of slope near the gutter adds to the safety of traffic and thus increases the width of effective or "available" roadway. By securing a wider distribution of traffic the life of the pavement is prolonged. On very wide roadways the slope from the quarter point to the gutter may be further advantageously decreased by substituting a straight line slope for the usual curve slope.

It will be seen from Fig. 1 that the decreased rate of crown slope results in a saving in the cost of excavation, which is no

mean item when the cost amounts to one to two dollars a cubic yard, as it has the past year in Chicago.

*Curb Corners*

The radius of curb corners has been increased. The standard for the typical residence street is a 10 ft. radius at street intersections and a 6 ft. radius at alley returns. For business streets the general radius of 6 ft. is employed for both street and alley corners.

On wider streets and streets having certain kinds of traffic predominating larger radius corners are being used.

This improvement has the following advantages: It adds to the convenience and safety of traffic; it improves the appearance of the intersection, and reduces the destruction of curbing at the curb corners. While the area of pavement is increased, the amount of curbing is reduced. The difference in cost is money well spent. The combined curb and gutter used in Chicago has a curb 7 ins. thick and a gutter 8 ins. deep and 12 ins. wide. This section has proved amply strong and is now standard construction. Table 1 shows the "minus curb" and "plus pavement" for one curb corner of radii from 3 to 25 ft. This table is convenient when preparing estimates and determining fatal quantities. Columns 4 and 5 give plus area of pavement where straight curb is used, and columns 6 and 7 where a curb and gutter is used.

*Depth of Gutter*

The depth of the gutter below the top of the curb has been reduced. Where combination curb and gutter is used this improvement results in a saving in cost of curb and gutter, a neater appearance and less breakages of curb.

On all streets, this elevation of the pavement, as it were, results in a saving in amount of excavation and furnishes more support to the curb on the roadway or pavement side. Consideration is being given to the use of a uniform section of curb and gutter, having a low curb, on narrow residence streets.

*Street Crossings*

On residence streets pedestrian traffic is rendered safe and convenient by reason of paving the cross walk at street intersections and at alley returns even with the top of the curb for a distance equal to the width of the adjacent sidewalk. This eliminates the old step and dangerous gutter opening formerly used, which was a source of accidents and damage suits against the city.

By reason of using a flatter crown section, larger radius corners and a low crown height at street intersections, this improvement in street crossing is readily effected without inconveniencing vehicle traffic.

*General*

Concrete foundation is used under all types of pavement except macadam. It is usually a 1:3:6 mix, varying from 6 to 8 ins. in depth, depending on the traffic and the condition of the subgrade. Asphaltic concrete (Topeka mix) has been abandoned because of its general failure due to lack of stability. The depth of the binder course on sheet asphalt pavements will probably be increased to furnish greater stability to meet heavier traffic conditions. Brick pavements are laid with a mortar cushion 1 in. thick and a filler of grout or preferably asphalt. Tar filler is not specified. The asphalt filler protects the edges of the brick and forms a mat wearing surface which fills any inequalities in the surface and thus maintains a smooth, durable surface. On car line streets three or four rows of granite block are laid parallel with the rail. The granite withstands vibration and takes the excess wear occasioned by the vehicles turning off and on to the car tracks. Sandstone blocks are being specified on heavy traffic streets where the grade exceeds 2 percent. It affords safe traction and wears smooth.

TABLE I—LENGTHS OF CURB AND PAVEMENT AREAS FOR ONE CURB CORNER FOR RADII FROM 3 TO 25 FEET.

By H. J. Fixmer, Division Engineer, Board of Local Improvements, Chicago, 1918.

| Radius of Curb Corner In Ft. | Length of Curb (¼ Circum.) Lin. Ft. | Minus Curb Lin. Ft. | Plus Area of Pavem't (One Curb Corner) Straight Curb Sq. Ft. | Straight Curb Sq. Yds. | 12 in. Wide Gutter Sq. Ft. | 12 in. Wide Gutter Sq. Yds. |
|---|---|---|---|---|---|---|
| 3 | 4.71 | 1.29 | 1.93 | 0.21 | 3.43 | 0.38 |
| 4 | 6.28 | 1.72 | 3.43 | 0.38 | 5.36 | 0.60 |
| 5 | 7.85 | 2.15 | 5.36 | 0.60 | 7.72 | 0.86 |
| 6 | 9.42 | 2.58 | 7.72 | 0.86 | 10.52 | 1.17 |
| 7 | 11.00 | 3.00 | 10.52 | 1.17 | 13.76 | 1.53 |
| 8 | 12.56 | 3.44 | 13.76 | 1.53 | 17.63 | 1.96 |
| 9 | 14.14 | 3.86 | 17.63 | 1.96 | 21.46 | 2.38 |
| 10 | 15.71 | 4.29 | 21.46 | 2.38 | 25.97 | 2.88 |
| 11 | 17.28 | 4.72 | 25.97 | 2.88 | 30.90 | 3.43 |
| 12 | 18.85 | 5.15 | 30.90 | 3.43 | 36.27 | 4.03 |
| 13 | 20.42 | 5.58 | 36.27 | 4.03 | 42.06 | 4.67 |
| 14 | 22.00 | 6.00 | 42.06 | 4.67 | 48.28 | 5.36 |
| 15 | 23.56 | 6.44 | 48.28 | 5.36 | 54.94 | 6.10 |
| 16 | 25.12 | 6.88 | 54.94 | 6.10 | 62.02 | 6.90 |
| 18 | 28.28 | 7.72 | 69.52 | 7.72 | 77.50 | 8.60 |
| 20 | 31.42 | 8.58 | 85.85 | 9.54 | 94.65 | 10.52 |
| 25 | 39.27 | 10.73 | 134.12 | 14.90 | 145.10 | 16.12 |

*Construction*

Probably the most noteworthy innovation in construction the past year was the mixing of concrete for the pavement base at a central plant and hauling the concrete in motor trucks to the streets under construction. On the job in question about

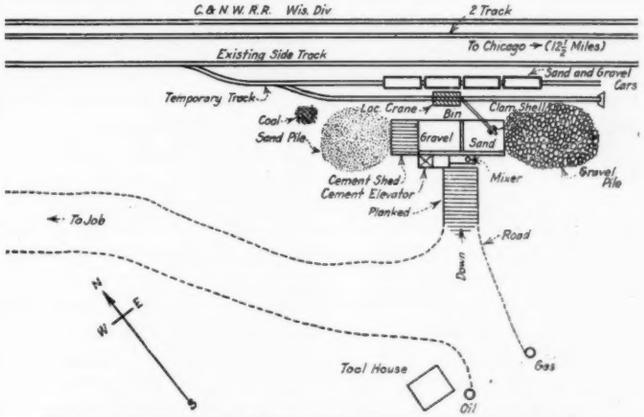


FIG. 2—CENTRAL CONCRETE MIXING PLANT LAYOUT. CONCRETE HAULED FROM PLANT TO STREET UNDER CONSTRUCTION IN MOTOR TRUCKS.

13,500 cu. yds. of 1:3:6 mix concrete were handled. The base was 6 ins. thick and amounted to about 80,500 sq. yds. The width of roadways on this system of streets was proportioned according to the traffic need or character of frontage, and were 18, 24 or 30 ft. in width.

The mixing plant was installed alongside a temporary siding off the main line of the C. & N. W. Ry. (See Fig. 2.)

The plant required two temporary switch tracks, on one of which a locomotive crane operated, transferring the sand and gravel from the cars on the adjacent track to two elevated bins of about 50 cu. yds. capacity. In addition to the bins, large stock or storage piles were built up to anticipate car shortage.

Adjoining the bin on one side was a ground level cement storage shed. The mixer was erected on the side of the bins away from the switch tracks, with the discharge chute about 6 ft. above the ground. In front of the mixer a depressed planked road was built to enable the trucks to back in and receive their load. The cement was raised onto the charging platform by an improvised elevator, which was hoisted and lowered by a rope attached to the drum which ordinarily operates the charging hopper of the mixer.

The engine man on the mixer operated the elevator, admitted the water and lowered and raised the discharge chute. The sand and gravel were proportioned in an old asphalt measuring box, which was divided by a plate set one-third the over-all length from one end. It held 6 cu. ft. of sand and 12 cu. ft. of gravel, which was discharged into the mixer along with two bags of cement. One man operated the chute doors that filled the measuring box and likewise released the contents of the box into the mixer. The standard batch was a two-bag batch and produced ½ cu. yd. of concrete.

The concrete was hauled by Mack trucks, four, five or six being used, depending on the haul, which averaged less than a

mile. The time of haul from mixer to street varied from 10 to 20 minutes. Each truck carried four batches, which would lay 12 sq. yds. of base. A fair day's average was 1,800 sq. yds., with a maximum of 2,250 sq. yds.

When the trucks reached the subgrade they were backed onto the previously laid concrete a distance of about 4 ft., and then dumped from the end by elevating the body. In this way the slush, which occasionally separated from the concrete mass, was automatically spread over the concrete in place and not wasted. To facilitate dumping and prevent an excessive separation of the aggregates a division plate was built at an angle of 45 degrees near the forward end of each truck.

There was practically no leakage and the concrete was a uniform and generally excellent product. The crews at the plant and on the street were about equal, each having, as a rule, 10 to 12 men.

The type of trucks used was the standard 7½-ton Mack truck, equipped with bodies designed to carry asphalt mixtures. They proved highly efficient and not only served to overcome the shortage of labor that prevailed at the time, but were instrumental in effecting considerable saving to the contractor. The same type of trucks was used to haul the sheet asphalt surfacing from a plant about 5 miles away.

The use of grading machines increased the past year. Many different types were used, depending usually on the amount or difficulty of the cut. The scarcity of dumps, together with the increased cost of labor and teams, caused prices to increase regardless of all economies secured through the use of machines.

The mileage of pavement laid during 1918 was about one-half the normal mileage, and was divided as follows:

| | |
|---|---|
| Sheet asphalt | 41.53 miles |
| Asphalt macadam | 8.86 miles |
| Brick | 10.23 miles |
| Concrete (alleys) | 14.43 miles |
| Creosoted wood block | 1.01 miles |
| Granite block | .71 miles |
| Total | 76.77 miles |

## Some Conditions Observed in Public Utility Plants by a Representative of the U. S. Fuel Administration

*By Charles Brossman, Consulting Engineer, Power and Utility Plants, U. S. Fuel Administration, Merchants Bank Bldg., Indianapolis, Ind.*

There are no restrictions on coal at present. The utility plant can uses all it wishes—at the price. However, with so many utilities during the past year asking for surcharges, we find the main reason is increased operating expense, with fuel as one of the main factors, so that it is quite evident that the price of fuel is still of considerable importance. Granting this, some of the things found in utility plant practice by the U. S. Fuel Administration were peculiar. The conditions found are not necessarily confined to municipally owned plants, but in the private plants as well, although probably not to such a great degree, said Mr. Brossman, in addressing the Indiana Engineering Society.

It is of interest to note the following encouraging news item from a paper of only a few days ago, in which one large company withdrew its plea for a rate increase, stating that they had determined to see if they could overcome some of their excessive expenses through reduction on the price of coal and better operating conditions. This is a gleam of encouragement, and it is to be regretted that this stand has not been taken more often, at least to endeavor to cut down expenses partially, so that the surcharge asked, where necessary, need not have been so great.

### *Means of Reducing Expenses*

There have been several means of reducing expenses in utility plants. These can be divided into two general classes—one the matter of interconnection between utility and power plants, where in one case the larger plant will usually be more economical of operation and where the interconnection would result in the saving either of fuel or labor or both. The other is the question of reducing operating expenses.

### *Interconnection of Utility and Power Plants*

The mere fact that interconnection could be made between a smaller and larger plant does not necessarily mean that there would be a saving. A number of such cases have been carefully investigated, and in some cases it has been found possible to save and in others the interconnection would show even a greater fuel consumption.

### *Examples*

I am going to mention a few of these instances. In investigating a utility on the question of interconnection, the practice was made to get all possible details of operation and in numerous cases actual tests were conducted on the plants in question, so that the possible fuel saving could be determined. The fuel administration was not concerned in the dollars and cents saving, but the main object was the conserving of fuel, but with this information determined it then became an easy matter for the plants concerned to find out what the saving in money would be.

### *Lack of Foresight*

One thing that stood out very plainly in some of the plants, was the lack of engineering foresight used and emphasis should be placed on the fearlessness with which some public

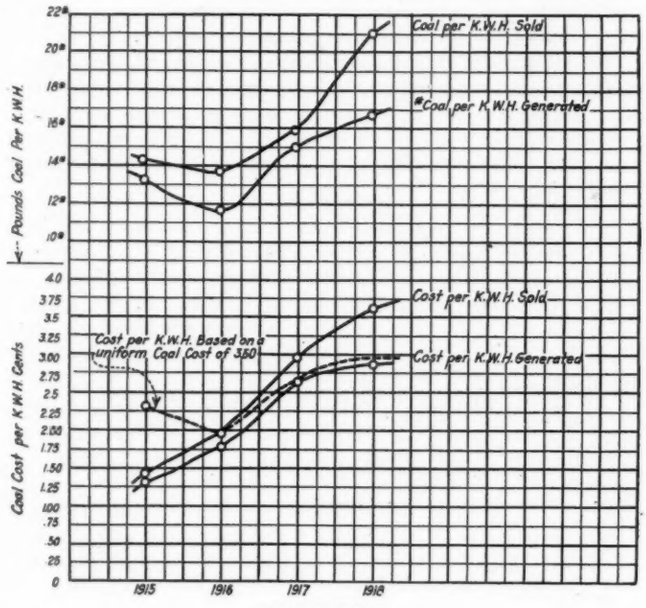


CHART NO. 1.

officials had determined off hand engineering problems that a competent and trained engineer might spend several weeks in investigating and figuring in order to get the best results.

### *Lack of Records*

Another was the method of operating some of these plants without records of any kind, without any effort to determine costs and with no knowledge whatever of the comparative results of their plant as compared with others. In one instance, the superintendent of the light plant was not allowed in the power house and could only look after the street equipment. The power house was looked after by one of the public officials and changes were being made that at that time seemed absolutely unnecssary.

One place the designer was abused for putting in a certain recording device, and yet the device was not operating, although it was of fine, standard equipment, but absolutely no records were kept and the question of rates were up at that time for an increase. Just think of a plant using anywhere

from 16 to 20 lbs. of coal per K. W. (see Chart 1) and selling current to the water department for 30 per cent. less than it cost to make it. Here the current was generated by a small generator operated by a slide valve engine, running with a back pressure and then pumping water with a motor and centrifugal pump, while right in the plant stood a compound pumping engine, on which the overall steam rate for pumping would have been considerably less than on the centrifugal.

What encouragement is there to an operating engineer, who is ordered to discontinue keeping records? Is it any wonder that such plants should be using almost twice as much coal as necessary. On questioning the fireman, he said he had only worked there three days and I believed him for I counted 27 shovels full of coal going under that boiler at one time.

*Investigating Suggested Interconnection*

In another plant the question of interconnection was brought up and careful tests were made on both plants considering the interconnection. This was a municipal light and water plant, and interconnection was considered with a much larger private utility. Loads of both plants were carefully taken and actual coal tests made under several different conditions and in this plant it was found that a saving of almost 1,000 tons a year could be made. In this plant, which was a municipal plant it is commendable that the superintendent had already previous to this, cut down his coal consumption on the electric end to a considerable degree, so that the saving of about 1,000 tons a year, was what was shown after increased economy in the plant had been obtained.

The main reason for this further saving, was in the difference of the size and loading of the machines in the two plants. The large plant having almost three times the capacity of the smaller plant. In this case, the smaller plant was operating at only one-quarter load and they were using for this work about 6,000 lbs. of coal to make the run during the night. A test operated on the larger plant with them pulling the additional load to their own, showed that only 1,000 lbs. additional coal was used to do this same work. (See Chart 2.) This was due to the fact, that their night load was poor and adding this additional load, it gives them a much better load factor. It is of interest to note however, that even in this larger plant, no scales were used for weighing coal until the fuel administration asked for this test.

In this case the question of electrical pumping was not considered, as no coal saving would have resulted, due to the fact that the municipal plant was pumping its water with a compound Corliss condensing engine and was using less coal than would have been used by the larger plant to pump electrically .

Chart 2 shows the curve on a test 750 K. W. H. turbine. This test is of interest as from the coal used and the loads taken for 60 hrs., an average curve has been drawn, which shows the overall station efficiency. It is of interest to note that the total coal consumption divided by the total K. W. H. load, coincides with the average curve drawn.

As there may be some who might not understand how we get the 1.12 lbs. coal per K. W. H., this is figured as follows:

| | K. W. H. | Coal. |
|---|---|---|
| Load with street light load | 2,920 | 21,000 lbs. |
| Load without street lights | 2,040 | 20,000 lbs. |
| Used by street lights | 880 | 1,000 lbs. |

It will thus be seen that to carry the 880 K. W. H. for street lights, it requires 1,000 lbs. of coal or 1.12 lbs. coal per K. W .H. It must be remembered that this is not the overall pounds per K. W. H., but it is the proper figure to use for comparing the coal saving, between this plant and the other plant.

*Steam Pumping Sometimes Most Economical*

There seems to be among a good many central station men, the idea that any electric pump can be operated more economically than any steam pump. This may not be the case. Of course, where labor is saved, that will some times offset what might be lost on coal. I wish to mention a case where considerable agitation had been made to pump the water of the municipal plant and in this case, the considered interconnecting company had a fair sized plant, but it was found that for them to furnish current for pumping, as compared to the city's steam pump, would have resulted in an actual loss of fuel and it was pretty hard to convince the company officials that such would be the case. This was apparently due to the fact, that they did not realize that a high duty crank and fly-wheel condensing pumping engine, had almost as low a water rate as their large electric unit. However, they were finally though reluctantly convinced.

In another instance of interconnection on water plants, it was found and recommended that electric driven centrifugal pumps as compared to the old non-condensing duplex, would result in a saving of fuel and labor, that would pay for the investment in a little over four years time. In this case, the city went ahead and made arrangements to change over.

From the above it will be seen that there is only one safe thing to do and that is to investigate every case carefully.

*Some Good Plants*

It must not be thought all the plants examined are horrible examples. Some of the medium sized plants found in the state, were operating as low as 4½ lbs. of coal per kilowat. In this plant last mentioned, the manager has well kept records

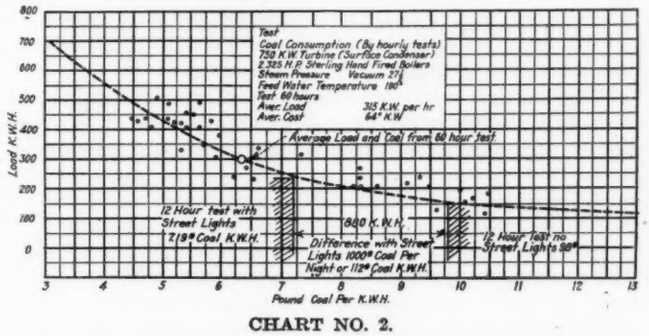
Test
Coal Consumption (8g hourly tests)
750 K.W. Turbine (Surface Condenser)
2,325 H.P. Sterling Hand Fired Boilers
Steam Pressure Vacuum 27"
Feed Water Temperature 180°
Test 60 hours
Aver. Load 315 K.W. per hr
Aver. Cost 64* K.W
Average Load and Coal from 60 hour test
12 Hour test with Street Lights 719# Coal K.W.H.
880 K.W.H.
Difference with Street Lights 1000# Coal Per Night or 112# Coal K.W.H.
12 Hour test no Street Lights 569#
Load K.W.H.
Pound Coal Per K.W.H.

CHART NO. 2.

of all loads and conditions and he could give on a moment's notice any information regarding the operation of his plant.

It is rather interesting to know that most of the plants that keep no records and have no means of determining what they are doing are the uneconomical plants. I recall an installation, which reminded me of the way a green Irish conductor rang up his fares. "Here, Mike," said the inspector, "you have ten passengers and nine fares." "Is that so," said Mike, "then there is too many of ye on the car, one of yez get off of here." In this particular boiler plant, I think of, they had the scales, coal cars and water meter, but the firemen only went through the action of weighing and taking the water records, and put them down so that they looked "about right."

*Burned Coal to Keep Cars Moving*

Another instance, one operating engineer said he had been jumped by the Councilmen, because he did not get the cars of coal off of the switch fast enough, as they had no place to store it. "The other engineer burned it faster than you do and I do not see why you can't do it," was the argument.

In one plant the records were fairly well kept, it was found that they were using from 6½ to 7½ lbs. of coal per K. W. H. generated and which looked fairly good on the face of it. An analysis of the boiler flue gases, only showed about 4 to 6% $CO_2$. It is quite evident that with such a showing, there is no reason why the coal per K. W. H. should not be further reduced and this is being accomplished in this particular plant. Some of the plants visited had the necessary equipment to take the proper tests, but despite the fact, they claimed that they were losing money without trying to better conditions as they should have done.

*Improper Operation*

An analysis of the trouble of many of these plants shows that a large part of their loss is due to improper boiler room operation and not keeping the proper records or properly analyzing them. There have been many plants where from 10 to 20% saving in coal could be made, simply by changes in operating methods. This is one of the important lessons that should be taken advantage of.

Another most important thing is the method in which new equipment is purchased, without any analysis of operating loads and conditions and on the hit and miss theory. This trouble comes more from the municipal plants, although a number of such cases were found in the private utilites. I make the assertion that thousands of dollars are wasted every year in municipalities, by improper purchasing without expert engineering advice and without careful engineering analysis of the true conditions.

*Conclusions*

The important lessons shown from the fuel administration work are:

That too little attention is paid to the proper and economical operation of the plant, as pertaining to the boiler room, as the greater proportion of loss of the plant seems to take place in the manufacture of the steam.

That interconnection in numerous cases would be advisable, owing to the character of equipment, and combined with better methods of operation, where economical central stations have power available, advantage should be taken of the possibility of interconnection, when these uneconomical plants can be placed on a sound basis.

That an important reason for low economy is the method of purchasing new equipment and making additions to plants without any regard to the adaptability of the units purchased. More attention should be given to getting the exact working conditions of the plant and paying more attention to economical machinery and purchasing new plant equipment.

I believe that the time has been reached on public utility plants with any kind of power plant, where strict attention must be given to proper design and purchase and more accurate methods of operation. If such things were looked after, there would be much less trouble and fewer failures in such plants.

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## Baltimore Adopts Feeding for Disposal of Garbage

*By Walter E. Lee, Water Engineer of Baltimore, Md.*

A feeding contract for the disposal of garbage was awarded by the city of Baltimore on Dec. 21, 1918, for a period commencing May 1, 1919, and ending Dec. 31, 1923, under which the contractor will pay the city an annual sum of approximately $31,500. Barging and towing costs reduce this by $15,000, leaving an annual net return of $16,500.

*Studies Made*

The city of Baltimore for over two years made extensive studies and exhaustive investigations on the method of refuse disposal which were best suited to the local conditions and the writer in a report of Jan. 28, 1918, to Mayor James H. Preston, recommended that garbage be disposed of by reduction in one central plant, ashes by filling ravines, low marshes and swampy ground along the water front for reclamation of land, and rubbish by incineration of the combustible portions, except the recoverable merchantable articles, in three municipal incinerators.

*Former Disposal Methods*

The history of garbage disposal in the city of Baltimore has been successively dumping on ground, reduction and finally feeding. From 1882 until 1901 the garbage was barged to a point six miles below the city by a contractor and there spread over the ground as a farm fertilizer.

A contract for ten years was awarded commencing Oct. 20, 1902, at an annual payment to the contractor of $147,300, for the collection, removal and disposal of garbage and a reduction plant employing the Arnold-Edgerton system of digestion was erected in the heart of the city near the water front, to which the collection carts of the contractor made a direct haul.

Complaints on the non-collection of refuse became so numerous and objections to the odors from the reduction plant were so strong, that the city terminated the contract on Jan. 1, 1908, and purchased the collection equipment and reduction plant from the contractor at the price of $372,888.19 and placed directly under the commissioner of street cleaning the collection and removal of garbage from residences.

A second reduction contract was awarded in 1908 for ten years, terminating Dec. 31, 1917, at an annual payment to the contractor of approximately $75,000. A new company was organized and the reduction machinery leased from the city at an annual rental of $10,000. At the expiration of this contract, it was extended for a period of one year until Dec. 31, 1918, at the request of the city, under which extension no rental was paid for the use of the city's machinery, so that the cost of disposal in effect amounted to $85,000.

*Recovering Values*

The specifications recently issued by the city contemplated in the disposal of garbage:

1. That the garbage should be utilized in some way to recover the values contained in it, either by the production of grease and tankage or by increasing the weight of hogs.
2. That the method of disposal should be sanitary in all respects and not liable as a nuisance.
3. That a payment per ton be made to the city for all garbage delivered to the contractor.

*Specifications Covering Reduction Method*

The first specifications for disposal by reduction in furtherance of the recommendation of Jan. 28, 1918, were advertised in March and opened on April 17th, 1918. It asked for proposals offering a lump sum payment year by year to the city under an eleven year contract and obligated the city to deliver to the contractors all garbage produced from all sources within the city of Baltimore.

The specifications defined garbage as being every accumulation of animal, fruit or vegetable food waste, containing not more than 5% by weight of other refuse, generated by or resulting from the decay, deterioration, storage, preparation or handling of animal or vetgetable matter in any place or at any point where food is prepared for human consumption, including all kitchen and dining room refuse.

The contractor was required to receive the garbage at the water front dumping stations provided by the city and convey it on his own scows and by his own power to the site of the reduction plant.

The specifications stipulated that the garbage should be handled and disposed of under a "closed" system of reduction so as to prevent the emission of offensive odors of any kind while being handled, treated or reduced, and that the process, machinery and apparatus be thoroughly sanitary in effect and the plant so conducted as not to cause conditions which would be detrimental to the public health or comfort, or in any way constitute a public nuisance.

All gases carrying odors which were produced or resulted from the operation of the process, machinery or equipment used, were to be confined and before being liberated to the atmosphere were to be thoroughly deodorized. All water flowing from the plant was to be inoffensive, free from nuisance dangerous to the public health or to the oyster beds in the Chesapeake Bay or its tributaries.

It was further specified that the city should have the option of purchasing the plant and equipment from the contractor at the expiration of the contract, and that the reduction site should contain not less than 5 acres, situated on at least one railroad or above high tide on a navigable waterway.

*Bids Asked and Received*

Under the first specification a flat offer of 35 cts. per ton was received which would employ the Cobwell process of reduction but the city failed to secure the approval of the Capital Issues Committee on the necessary stock issue for the erection of a plant of 350 tons per day capacity, and the bid was subsequently released.

A second specification was advertised on Oct. 2, and opened Oct. 16, 1918, under which the city obligated itself to do the same things as in the previous specifications and asked for alternate proposals on disposal by reduction or disposal by feeding. The reduction contract was for 16 years and offered the prospective bidders, without charge, the use of machinery which the city owned in the existing plant for re-erection and operation in a temporary plant until the end of the war, after which a permanent plant was to be erected. The contract for feeding was for 5 years. No bids were received under either reduction or feeding.

A third specification was advertised on Dec. 6, and opened Dec. 18, 1918. Under this specification the city undertook the delivery of garbage from the water front stations to the contractors' disposal site, as the city realized that the collection and removal of garbage from its water front dumping stations was simply an extension of the collection and removal from the residences, and a matter in which the contractor has no primary interest. The towing of garbage was a proper function for the city to undertake, for when any contractor is required to undertake it, the public at large is not always satisfied with the way in which the work is done, but when done by the city the public always has the proper remedy for getting a quick and adequate response to its complaints on the accumulation and non-removal of garbage from the water front stations.

An act of the Maryland Legislature prohibits the erection of a garbage reduction plant within a nine mile radius of Lazaretto Light, a shore light in Baltimore Harbor, and consequently any possible site for such a plant would involve a barging distance of 16 miles from the water front dumping station in the city and 4 hours of towing either way.

Alternate proposals were again asked on disposal by reduction or by feeding. The term for reduction was 16 years and a flat price per ton was requested with an adjustment, to be stated by the bidder, in cents per ton for every upward or downward fluctuation in the market value of grease from a basic price of 8 cts. per pound, as the city felt that it should share this risk with the contractor so that all elements of gambling in making a bid should be entirely removed.

The term for feeding was five years, commencing May 1, 1919, and bids were requested on an annual flat payment to the city for each ton of garbage delivered to the feeding site.

No bids were received under disposal by reduction, and one bid was received under disposal by feeding. The contractor operating the present reduction plant made no formal offer.

*Contract Awarded for Disposal by Feeding*

A contract was awarded on Dec. 21, 1918, for disposal by feeding and the price to be paid to the city for each ton of garbage delivered is 3½ times the price per pound of live killing hogs on the Chicago market, as determined by averaging the top prices for each month. The scales for weighing the garbage are located at the feeding site and all garbage is drained before weighing.

*Temporary Disposal by Burial*

Until May 1, 1919, at which time the piggery shall take the full quantity of garbage produced, the city of Baltimore with its own forces will temporarily dispose of its garbage by burying it in shallow trenches 18 ins. deep and 5 ft. wide, in which the garbage is placed 12 ins. thick and covered with 6 ins. of sandy soil. There will be 17,000 lin. ft. required to accommodate this temporary disposal of garbage until the piggery is in operation. The cost of the temporary disposal is 85 cts. a ton against a former cost of $1.06 per ton under reduction, the towing cost being included in both figures.

*Contract Provisions*

The contractor pays for all household garbage delivered and for those portions of market refuse derived from an animal source, but not for that from a vegetable source or for any packing-house refuse.

The city obligates itself to enforce good primary separation and to deliver the garbage in as fresh a condition as possible to the feeding site, with not less than four deliveries per week in summer and three deliveries per week in winter.

The contractor is given the privilege of using the empty city scows, without charge, on their return trip to the city for the transportation of the products of the piggery.

The 160 acre farm, on which the feeding operations will be conducted, is almost level and has sandy soil insuring good drainage with considerable water through an extensive shore line. Scrub pine, chestnut and oak timber affords protection from the summer heat. The farm is owned by the city and was purchased at an average price of $140 per acre. It is situated on a point on the opposite side of the tributary of the Chesapeake Bay on which the existing garbage reduction plant is located and this proximity to a plant which has been operating 11 years without any formal complaint or restraint, will insure a like operation of the piggery.

The specifications require that the piggery shall be operated subject to the general and local public laws and under the supervision of such veterinarian and sanitary officers of the county and state having proper jurisdiction.

The city will also employ a veterinarian who shall have continual supervision and inspection over the work of the piggery.

The garbage which is unfit for feeding or not consumed shall be removed from the feeding platforms, which shall be cleaned at least once a day, and disposed of by the contractor through sale or by plowing under the soil.

The area of Baltimore is 80.5 square miles and the estimated population, with the recently annexed territory, is 720,000. The quantity of garbage produced and the seasonal fluctuation is shown in the accompanying tables.

*The Hogs*

It is estimated that 15,000 hogs will be required to consume the maximum amount of garbage produced during the summer peak and it will probably represent the largest piggery in the world and Baltimore will be the largest city of the United

TABLE I—YEARLY COLLECTION OF GARBAGE AND DEAD ANIMALS, IN TONS, OF BALTIMORE, MD., 1908 TO 1918.

| Year | Garbage Production, Tons | Number of Dead Animals | Estimated Population |
|---|---|---|---|
| 1908 | 54,000 | 13,754 | 569,000 |
| 1909 | 46,900 | 14,637 | 576,000 |
| 1910 | 44,500 | 17,790 | 559,000 |
| 1911 | 48,300 | 19,792 | 565,000 |
| 1912 | 49,200 | 20,498 | 568,000 |
| 1913 | 54,400 | 16,561 | 573,000 |
| 1914 | 59,100 | 15,993 | 578,000 |
| 1915 | 61,500 | 14,459 | 583,000 |
| 1916 | 62,400 | 17,419 | 588,000 |
| 1917 | 62,300 | 20,178 | 593,000 |
| 1918 | 51,324 | 16,464 | 670,000 |

TABLE II—MONTHLY FLUCTUATION IN GARBAGE PRODUCTION AT BALTIMORE FOR THE YEARS 1917 AND 1918.

| Month | 1917, Tons | 1918, Tons |
|---|---|---|
| January | 4,566 | 3,272 |
| February | 3,089 | 2,081 |
| March | 3,594 | 3,030 |
| April | 3,334 | 3,081 |
| May | 4,979 | 4,570 |
| June | 5,475 | 4,207 |
| July | 7,577 | 5,570 |
| August | 7,399 | 5,267 |
| September | 6,886 | 4,904 |
| October | 7,096 | 6,657 |
| November | 4,517 | 4,392 |
| December | 3,749 | .... |
| | 62,261 | *51,324 |

*Estimated from eleven months' collection.

States which has adopted this method for its disposal of garbage.

Young shoats, vaccinated with cholera serum, will be purchased in the open market and shipped to the feeding station, where approximately 100 animals will be placed in feeding lots, 70 x 250 ft. in size.

*The Handling Equipment*

Garbage will be unloaded from the city's scows at the feeding site by the contractor by the use of a locomotive crane with a grab bucket of 1 yd. capacity.

The garbage will be dropped into steel rocker double-side dump cars of 10 yds capacity each, on an adjacent track and hauled by an oil-burning locomotive directly down a lane between the feeding lots.

The end of the feeding lots adjacent to the railroad will have a monolithic concrete feeding floor from which the animals are excluded by wide gates when the garbage is being dumped from the rocker-side dump cars.

When the train has traveled to the full length of its trip, the garbage will be spread on the return trip to the wharf by a spreader from the rear end of the train, after which the gates will be opened and each lot of hogs allowed to enter on the concrete feeding floors to eat the garbage.

*Conclusion*

Disposal of garbage by feeding involves a relatively small capital investment which can be quickly and almost wholly liquidated at the expiration of the contract and in this respect differs from all reduction plants in which the machinery is of little use for any other purpose and possesses only a scrap value.

Feeding is a reliable method and one which offers the highest financial returns to a municipality. It is absolutely essential, however, that the responsibility of the bidder be determined beyond the shadow of a doubt, which is usually satisfied when there is sufficient training in animal husbandry and practical experience by the bidder in previous sucessfully managed piggeries.

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## Efficiency of Bituminous Surfaces and Pavements Under Motor Truck Traffic

*By Prevost Hubbard, Chemical Engineer, U. S. Bureau of Public Roads*

The title of this paper covers a subject upon which a great deal of thought has been spent by progressive highway engineers as applied to pre-war traffic conditions and its progressive normal development. Many engineers had, at least in their own minds, classified the various types of pavements with relation to their efficiency under ordinary variations of traffic encountered on county, state and municipal highways and their ideas were fairly well fixed on the subject as evidenced by more or less consistent practice in their choice of types when reconstruction or new construction became necessary.

*Old Rating of Bituminous Types*

Just where the dividing line should be drawn, so far as traffic is concerned, between different types of pavements has always been a matter of individual opinion, but in general with increases in volume of weight of traffic the increasing efficiency of the bituminous types has been rated as follows:

1. Bituminous Surfaces.
2. Bituminous Macadam.
3. Bituminous Concrete.
4. Sheet Asphalt and Asphalt Block.

*Traffic Changes*

Suddenly and with little opportunity for anticipation, a very large mileage of our important state highways and many of our local county and municipal pavements were subjected to a tremendous increase in traffic. This increase was not only in volume, which would have presented a comparatively simple problem to solve, but in the weight and load carrying capacity of the individual vehicle. This, coupled with an unusually severe winter and immediately followed by war restrictions upon the use of many road materials, labor shortage, excessive costs, and loss of members of highway engineering organizations, created a situation during the year 1918 which was abnormally serious and complicated. With compartively few exceptions, new construction ceased and maintenance was so handicapped as to become inadequate.

*Road Failure Under Truck Traffic*

Hundreds of miles of roads failed under the heavy motor truck traffic within a comparatively few weeks or months. Roads with bituminous surfaces, bituminous macadam roads and bituminous concrete roads all failed alike, together with other types used in state and county work. These failures were not only sudden but complete and almost over night an excellent surface might become impassable. Such rapid and complete failures in municipal pavements were of less common occurrence and as sheet asphalt and asphalt block have always been largely confined to municipal work, failures of these types have not been noted to the same extent as the other types mentioned.

*Simultaneous Destruction of Entire Road Structure*

In the haste and confusion of war activities little opportunity has existed for a systematic and comprehensive study of the problem suddenly thrust upon highway engineers. Reports from all parts of the country have, however, established one outstanding fact which has a most important bearing upon any consideration of the efficiency of bituminous surfaces and bituminous pavements. A very large proportion of the failures have been characterized by an almost simultaneous destruction of the entire road structure, and not merely the disintegration of the wearing course or pavement proper. No type of pavement will be efficient unless provided with a foundation which will hold up the pavement until it is worn out. When, therefore, the entire structure fails suddenly, inadequate subgrade or foundation conditions are primarily responsible and but little basis exists for placing an efficiency valuation upon the wearing course.

*Foundation Failures*

Inevitably coupled with subgrade and drainage conditions, foundation failures occurring as previously described may be due to one of two causes, lack of thickness, or inability of the foundation structure to sustain the loads without appreciable internal movement. So far as bituminous surfaces or bituminous pavements are concerned, remedy of the first cause does not affect the general type of construction.

If, however, present heavy motor truck traffic is to continue and possibly increase in weight as well as volume the second cause may have a direct bearing upon possible modifications in design and in the ultimate determination of the efficiency of certain classes of bituminous work. Most subgrades have a much lower carrying capacity in the spring than at other periods of the year. As there is practically no slab effect produced by the structure of a broken stone or gravel foundation, a load applied to any overlying bituminous surface is transmitted quite directly to the subgrade. In other words, the intensity of load under its point of application is relatively high throughout the foundation thickness.

Under heavy motor truck traffic the intensity of load transmitted through a 2 in. thickness of dense bituminous concrete to the foundation may be so great as to cause an internal movement sufficient to produce disintegration of the pavement. This is particularly true when the subgrade is of a soft or clayey nature and appears to be quite possible irrespective of any economical thickness of broken stone or gravel foundation which may be used.

In general, the experience on heavily traveled city streets has demonstrated the necssity of a slab foundation for any wearing course and there appears to be no reason why such experience should not serve as a guide for new construction

of bituminous pavements on state and county highways subjected to modern heavy traffic. On these highways the traffic has certainly been as severe as on many city business streets, so far as weight of unit loads is concerned, and more severe when the high speed often attained by such traffic is considered.

*Surface Treatment with Bituminous Materials*

With respect to existing gravel and macadam roads, whether or not they have been previously surface treated with bituminous material, it would seem far safer at the present time to attempt to preserve such roads under heavy motor truck traffic by means of surface treatment with bituminous materials rather than to utilize them as foundations for the construction of new bituminous macadam or bituminous concrete pavements. In other words, for the time being such treatments may prove more efficient than the use of a higher type of pavement placed upon the existing road, although it is clearly recognized that, under heavy motor truck traffic, the bituminous pavements are more efficient providing the foundation is adequate to support the loads.

*Climatic Influences*

Under the same conditions of traffic bituminous surfaces are most efficient in localities where frost action is either absent or not severe. Such treatments used in connection with gravel roads adjacent to army cantonments in the far South have given reasonable satisfaction even under heavy motor truck traffic. North of the frost line and particularly in connection with the treatment of clayey gravel roads, which become soft during the spring months, bituminous surfaces are apt to disappear completely. If, however, the gravel road is maintained by dragging and at the end of the thawing out period is reshaped, thoroughly compacted and again treated with bituminous material, it may be kept in a reasonably satisfactory condition.

Under very heavy motor truck traffic, however, maintenance costs may be extremely high so that if a continuation of such traffic is to be expected the construction of a new road may be necessary. Thus, during a period of 120 days on a clay gravel road leading from Alexandria to Camp Humphreys, Virginia, which was subject to an average daily traffic of some 230 heavy motor trucks, the cost for maintenance amounted to approximately $10,000 per mile. Because of this enormous expense the construction of a new type of road became necessary.

*Failure of Base*

In connection with this road it is of interest to note that prior to its maintenance as a gravel road, it had served as a 6 in. foundation for a dense bituminous concrete pavement 2 ins. thick. This pavement has successfully passed a year of ordinary country and pleasure traffic carrying a large number of touring cars between Washington and Mt. Vernon. In the spring of 1918, it was suddenly subjected, to an average traffic of over 200 heavy motor trucks a day and within a comparatively few weeks was absolutely ruined, due to failure of the foundation during the thawing out period. An extension of this road in the city of Alexandria consists of a number of sections of very carefully constructed bituminous macadam laid some years ago upon a concrete base. Although subjected to the same heavy traffic, the bituminous macadam, ordinarily considered less efficient than bituminous concrete, did not fail except in a few places where failure of the concrete base could be held responsible owing to exceptionally poor subgrade conditions.

*Bituminous Surfaces on Macadam Roads*

Bituminous surfaces on properly constructed macadam roads subjected to heavy motor truck traffic may, as a rule, be maintained in localities north of the frost line with less expense and better results than on gravel roads under the same conditions. Such surfaces, under heavy motor truck traffic, cannot be considered as economical from the ordinary standpoint but may prove the most efficient temporary method of preserving the existing road until money is available for reconstruction. It is believed, however, that under these conditions bituminous surfaces will not even prove efficient unless constantly maintained by a patrol system operating throughout the year.

Maintenance by the Bureau of Public Roads of experimental bituminous surfaces on the Rockville pike, Maryland, which is a macadam road, have demonstrated that such surfaces constructed with suitable tar and oil products are efficient under reasonably heavy traffic, provided the patrol system of maintenance is followed. If such a system had not been in use during the past year when from 28 traffic counts an average of 135 motor drays, 816 motor pleasure vehicles, and 61 horse drawn vehicles per day passed over the road, it would from all indications have been completely destroyed.

*Bituminous Macadam Under Truck Traffic*

With regard to the efficiency of bituminous macadam under heavy motor truck traffic, there are a number of points to be considered. In general, bituminous macadam has not been thought to be efficient for such traffic but, on the other hand, it has almost invariably been placed upon a broken stone or gravel base. Results obtained in the city of Alexandria, which have previously been mentioned, indicate that if properly constructed and laid upon a concrete base the bituminous macadam may prove quite satisfactory.

Aside from character of foundation, it is believed that sufficient attention has not in general been paid to the important details of bituminous macadam construction so as to obtain best results. Too frequently the coarse stone is not sufficiently compacted before the first application of bituminous material is made and later uniform compaction is extremely difficult, if not impossible to secure. Rutting the road with certain types of distributors just prior to application of material is a common cause of lack of uniformity in compaction, and a strong tendency to distribute faster than the road can be satisfactorily compacted and finished by a single roller is another. Best results from this type of road which have come under the writer's notice have been secured by the hand pouring method, although this method is considered antiquated by many engineers. Where the first application upon the thoroughly compacted coarse stone is made diagonally across the enter line of the road and the second pouring or seal coat is made in a direction diagonally across the first, with proper attention to uniformity of distribution it is possible to secure a very excellent pavement, as has been repeatedly demonstrated by E. C. Dunn, City Engineer of Alexandria, Va.

*Bituminous Concrete, Sheet Asphalt and Asphalt Block*

The efficiency of bituminous concrete, sheet asphalt and asphalt block pavements under city traffic is so well understood as to require little comment in this paper. If laid upon suitable concrete foundations there is no reason to suppose that the results given by these pavements in city construction will not be duplicated on county and state highways subjected to heavy motor truck traffic. If the foundation is inadequate to support the load, the pavement is bound to fail, but, as previously pointed out, failure cannot then be considered a measure of efficiency of the pavement proper.

*Materials of Construction*

With regard to materials of construction a few comments may not be out of place, as the efficiency of a bituminous surface or bituminous pavement depends not only upon its method of construction but of what materials it is composed.

In general, the author's observation and experience has been that the most efficient bituminous carpets are constructed with the heaviest grade of bituminous material which it is possible to apply and make adhere uniformly to the road surface. For cold surface treatment this will demand either a cut-back asphalt, a heavy asphaltic oil with specific viscosity of 80 to 120 at 25°C. containing an appreciable amount of volatile material that will evaporate after application and leave prac-

tically an asphalt mat residue, or the most viscous refined tar product that can be applied cold. For the latter a specific viscosity as high as 25 to 35 at 40°C. should be used if climatic conditions will permit. While on old macadam roads it is advisable to keep the thickness of carpet under ½ in. on certain types of soft gravel it may be of greater thickness provided a hard and tough coarse aggregate cover of sufficient size to force into the old gravel surface by rolling is used. For clay-gravel or sand-clay-gravel roads north of the frost line it is believed that for maintenance under heavy truck traffic light superficial treatment with bituminous materials applied cold will prove more efficient than the construction of a bituminous carpet although neither will be adequate to carry the road through winter.

With regard to bituminous macadam and coarse aggregate bituminous concrete, there is little to suggest in connection with the grades of bituminous materials originally used. It is believed however that even in the northern United States the use of an asphalt cement softer than 120 penetration or a refined tar of less than 120 seconds float-test at 50°C. for bituminous macadam is inadvisable if modern heavy motor traffic is to be sustained. It is also believed that more attention should be given to specifying and securing a uniform size, and grading within reasonable limits, of coarse stone for bituminous macadam in order to promote uniformity in the penetration of the bituminous material as it is applied and to produce a surface that will wear as uniformly as possible. Such specifications should be based upon tests made with laboratory screens and should at least cover the permissible percentage retained on the maximum and passing the minimum diameter of screens selected, as well as the percentage limits required to pass or be retained upon an intermediate screen.

In connction with sheet asphalt and the fine aggregate bituminous concrete the tendency to use harder grades of asphalt cement than heretofore may prove advisable for very heavy traffic conditions. It is quite possible, however, that better results may be secured by a reduction in the compacted thickness of such pavements with a corresponding increase in thickness of binder course where one is commonly used. For fine aggregate bituminous concretes which are commonly laid without a binder course, the introduction of such a course not less than 1½ ins. thick may prove advisable with a reduction in the thickness of wearing course to not more than 1½ ins. Provided the binder course is properly constructed such practice should tend to produce a pavement less susceptible to displacement under heavy motor truck traffic. In any event it is believed that even more attention should be paid to aggregate grading than heretofore in order to produce most satisfactory results.

The resistance to displacement of compacted bituminous aggregates, containing particles from ½ in. in diameter down and consisting largely of sand, is mainly dependent upon grading of the mineral aggregate and hardness of the bituminous cement. When, however, the particles become very small and possess absorptive or colloidal properties neither grading nor consistency of the cementing medium are such important considerations. Very large surface contact and high frictional resistance then become the prime factors. Thus, a fine mastic composed of limestone dust or clay and a very soft asphalt cement may exhibit even greater resistance to displacement than a graded sand aggregate mixed with a much harder asphalt cement. The former type is exemplified by certain finely pulverized bituminous limestones. Use of the latter has but recently passed the experimental stage. It is quite possible, however, that future developments will establish such extremely fine bituminous aggregate as being highly efficient under heavy motor truck traffic for both the sheet and block type of construction.

The foregoing paper was presented at the 16th Annual Convention of the American Road Builders Association, Feb. 25, 1919.

## U. S. Department of Labor Creates Division of Public Works and Construction Development

A new division has been created in the Department of Labor for the purpose of interesting the nation in public works and private construction. Secretary Wilson announces that the new service will gather and distribute information that will enable private initiative to make the transition from a war to a peace basis without serious interruption, due to lack of data on which business judgment must depend.

A survey of business conditions will be made with a view to learning how labor and capital may be profitably employed during the critical period when factories are being made over for peace production and markets are being canvassed for future outputs.

The division which will carry on this work is now being organized by F. T. Miller, the publisher of construction periodicals, as a section of the Department's Information and Education Service, of which Roger W. Babson is chief. The new organization is called the Division of Public Works and Construction Development, and occupies the building at 16 Jackson Place, Washington, D. C.

*To Secure Data*

The particular objective of the bureau's research will be to secure data for the use of the construction industry, but the material to be collected will be so varied that the information will be of value to industry generally. The facts made available will be of help to any community or investor in determining whether it is advisable to undertake public or private building at present. When circumstances unfavorable to construction are discovered an attempt may be made to correct them, but there will be no stimulation of economically unsound enterprise. The finding of the bureau will be given the widest publicity.

The pivotal nature of the building industry in economic reconstruction and the general purpose of the work of this division are expressed in Secretary Wilson's statement:

*Secretary Wilson's Statement*

"Building construction will help to provide employment for returning soldiers and for workmen dismissed from war industries. One of the largest sources of prospective employment is the building trade and its allied factory industries.

"In the case of private construction, a resumption of activity will also lessen the congestion of population, improve conditions affecting the public health and convert inactive property into active property—which supplies the means that enable communities to support the functions of governments.

"During the war the nation practically concentrated all its efforts on the production of goods for immediate consumption —war materials, food, clothes. The failure to produce the normal quota of goods for future consumption has made these scarce and highpriced, and as they are essential to further production they affect the cost of production and, consequently, the cost of living. Chief among such goods are building and other real estate improvements, including public works, such as roads, bridges, etc. The scarcity of buildings, for example, creates high rents.

The inquiry will be under the direction of business men of wide practical experience who are serving without pay. The actual investigation will be conducted by a group of economists and special agents supplied by the Department of Labor and other Government departments or lent by universities. The field will include the cost and supply of building materials, the amount of labor available and its cost, the values of land, prevailing rents, the supply of capital, the amount of construction held up by the war and the demand for building in all parts of the country.

Under the supervision of the economics section, five other sections will prepare information for publication by the means of the press, public speakers, posters and the mediums of organized labor.

## Rigid Paving Inspection Needed to Cure the "Poor Grouting" Evil

*By Harlan H. Edwards, Highway Engineer, Highway Laboratory, University of Illinois, Urbana, Ill.*

With the approach of an era in highway construction unequalled in magnitude by anything in the past, it behooves those in direct charge of the various projects to take particular pains in the selection of their personnel so that first class workmanship may be assured at all times. This vigilance should be exercised especially in the construction of all grouted block pavements, for much good material and work has been ruined by a little carelessness now and then. It is upon the excellence of the grouting operations that the life of pavements often depends, and any poor work is bound to appear sooner or later.

In most specifications it is provided that all sand for grout must pass a No. 12 or No. 16 screen, yet on many jobs such sand is the exception rather than the rule. With some anything from ¼ in. down goes—with others, ⅛ in. material is satisfactory, yet unless extreme care is taken imperfect filling is bound to occur. The mixture is often made so stiff that it just bridges or plasters over the joints—or made so thin that a heap of separated sand collects below the machine, only to be brushed over the tops of the joints by some careless laborer. Often the first application only fills the joints in part, while the second is so stiff that it merely plasters over the top quarter-inch or so.

At any rate, the pressure of expansion of the pavement is concentrated on a small area at the top of the brick instead of being uniformly distributed over the entire area of the joint. The result we have all seen—the tops of the brick shattered and a rut or hole started. Many laymen place the blame on defective material, while the facts show that it is defective workmanship instead.

VIEWS ILLUSTRATING SEQUENCE OF OPERATIONS IN RECOMMENDED METHOD OF GROUTING A SEMI-MONOLITHIC BRICK ROAD.

(1) After the Brick are Laid and Rolled to a Smooth Regular Surface, and (2) Before Grouting, the Brick Surface is Thoroughly Wet Down, Cleaning the Brick and Moistening the Cement-Sand Bed. (3) The First Application of Grout is then made, Using Sand all of which will Pass a No. 12 Screen. This Grout is mixed to the Consistency of Ordinary Paint and Fills the Joints Completely. (4) After Settlement has taken Place, and Before the Grout has obtained its Initial Set, (5) a Second Application of Grout is made, this Time Somewhat Thicker than Before, but Using Always the Fine Sand which is more Easily Kept in Suspension. (6) This Time all the Joints are Filled and a Very Small Amount is left on the Surface to Provide for Future Settlement, if any occurs. This is now Allowed to Stand until the Initial Set is taking place at which Time (7) the Surface is gone over finally with a Squeegee, Moistening the Surface where Necessary with the Sprinkling Can and Cleaning the Grout off Flush with the Surface of the Brick. (8) This Assures Completely Filled Joints and a Smooth Pavement which is Cleaned by every Rain.

## The County Highway Engineer-Manager

*By E. E. Sours, Engineer, Mecosta County Highway Commission, Big Rapids, Mich.*

Many of the larger counties of Michigan have realized the value of a county highway engineer in the directing of their road building. Gradually some of the less wealthy counties, through the example set by the more populous counties, and through other influences, have hired highway engineers, said Mr. Sours, in addressing the Michigan Engineering Society.

At present there are 31 counties in Michigan employing county engineers on a salary. In general, as the engineers have gained the confidence of their commissions as to their ability to manage affairs, this work and authority have been gradually delegated to them.

The road funds of the county are spent on recommendation of the county engineer. It is a common criticism that public money is not spent wisely. In other words, it is charged, and too often justly, that those intrusted with the expenditure of public money do not get as great results, dollar for dollar, as do private enterprises under the same conditions. If the county engineer cannot do better work at less cost than the untrained man, the position of county engineer cannot be justified. It is up to the road engineer to produce results.

Technically, the work of the road engineer is the construction and maintenance of the county roads. How this can best be accomplished must be decided by the organization in each county. It might be well to mention in general some of the essential points which must be observed, if the greatest efficiency is to be secured.

### *Points to Observe*

To begin with, there must be entire harmony between the engineer and his commission. Too often the engineer makes the mistake of assuming a professional superiority over his associates, looking at all problems from a technical standpoint. The other fellow's viewpoint is always worth consideration, even if it is not based on mathematical hypotheses or engi-

neering principles. There is always something to be learned; when an engineer ceases to be a student he is retrogressing. Use tact with your commission, use tact with your foreman, use tact with the public. The best engineering education will avail little if one lacks tact and good judgment.

Some definite system must be followed. The work must be planned so that there are few mistakes and little lost motion.

Good judgment must be used in selecting subordinates. No matter how well plans are laid, if the ones to whom is intrusted the carrying out of the plans are lazy, careless or incompetent, the efficiency of the system is impaired. Every principal is responsible for the actions of his agents. Managers and engineers cannot shift their responsibilities. It is therefore up to the engineer to select the best material available for helpers. Thousands of dollars have been squandered in Michigan on roads by incompetent foremen, because they could be hired cheaply. Money is well invested in a good foreman, while a poor foreman is expensive at any price.

*Outside the County*

One may say that a county engineer's responsibility ends at the boundary of the county. But does it? The wide-awake, loyal engineer is larger than the county. That time is past when a local community is sufficient unto itself. The trunk line roads of the state are the main arteries of traffic, and are fed by the county system, and these again by the feeders in the township, so that the whole is a comprehensive system of highways, serving every community in the state.

Yet while the counties and townships both are working on the same system, they often work at cross-purposes instead of working hand in hand, and with the state, to complete this system. Local jealousies often defeat the interest of a community at large. The county and township organizations are often widely separated and fail to co-operate, often when it would be a mutual benefit to do so. Probably due to the old method of building township roads, the township organizations sometimes are inclined to resent what they choose to term "interference in their local affairs by state and county officials."

To the wide-awake engineer the law providing for the survey by county engineer of township roads may be made a means of making a closer relation between township, county and state. The county engineer is one of the important connecting links between the township and the state. A township commissioner is not unmindful of a little assistance from the engineer; competent advice, tactfully given, will reap a harvest of better roads and better bridges.

*A Co-operative Plan*

In this connection may be mentioned a co-operative plan which has been adopted by Mecosta county. As it is a pioneer move along this line it is worthy of consideration. It is not to be presumed that the authors anticipated all of its effects.

Briefly, the plan is as follows:

1. Any township, city, village or individual desiring to build a section of road on the county system makes application to the county road commissioners for a survey and estimate of cost of construction of the parcel of road.

2. The county engineer makes the survey and estimate and submits it to the applicant.

3. Such municipalities or individual electing to construct such road may do so under the following conditions: From the engineer's estimate of cost the estimated state reward is deducted. The township is paid 50 per cent. of the balance and the state reward.

The first payment is 40 per cent. of the engineer's estimated cost of building grade, which includes the culverts, and is paid when the grade is completed and accepted by the engineer.

The second payment of 40 per cent. of the engineer's estimated cost of placing the first coat of gravel is paid upon the acceptance by the engineer of the first coat of gravel.

Final payment is made of the balance due on the road, together with the state reward, when the road has been accepted by the State Highway Department.

If the one proposing to build the road is satisfied with the estimate he files a request with the board to that effect. A contract is then entered into between the contractor and the Board of County Road Commissioners. So far this plan is a source of satisfaction to its promoters. There has been application for survey and estimate of nearly every mile of unimproved road on the county road system.

*Advantages of the Plan*

This plan, while its main object is the early completion of the county road system without the necessity of a bond issue, at a minimum cost to the public, has more far-reaching effects from the standpoint of the engineer.

It brings the township and county road organizations in closer touch with one another; it admits of a closer supervision of the township roads by the county engineer, and tends to raise the standard of efficiency of the township commissioners.

Assuming that all of the townships accept the co-operative plan of building county roads, the township commissioners practically become county employes under the direct supervision of the county engineer. The commissioners will come to depend on the assistance of the engineer, thereby extending the engineer's influence over the construction of township roads. The benefit of this influence can be no better illustrated than in the case of bridges and culverts.

The commissioner builds the culverts on the county road, necessarily under contract, according to standard culvert plans of the State Highway Department. The wide-awake commissioner appreciates the better results secured under the instruction of the county engineer and uses his education to advantage in his later work in the townships. The county engineer has an opportunity through these commissioners to carry on a campaign against poor concrete and drainage work. This practice of building poor culverts, often with insufficient capacity to accommodate the drainage areas, necessitates their rebuilding within a very few years. It is not only a detriment to the roads, but is an unnecessary bill of expense, thousands of dollars being expended each year in repairing washouts and rebuilding culverts.

While the engineer may not have enough time at his disposal to supervise closely the building of culverts in the township, the fact that he can refer the township authorities to standard plans, and can give the workmen some instruction in the building of foundations and the handling of concrete, is bound to produce better results, especially if he has improved every opportunity to inspire in township officials a confidence in his ability and to create a demand for his service through a desire to be helpful to the local road builders.

Ordinarily one township commissioner is not interested in what the commissioners in the neighboring townships are doing. Under the co-operative plan all commissioners, being employes of the county and working to an estimate, are continually measuring their efficiency by the work of their fellow-commissioners. And, further, interested individuals in a township are comparing the work of their commissioner with the work of the commissioner of neighboring townships.

The effect of these comparisons will tend to make the qualification of a road builder the controlling factor in the selection of the next commissioner, which has not always been true in the past.

Not the least of a county engineer's duties, speaking in a broad sense, is the education of the road men of his county.

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## Preventing the Opening of New Pavements

One of the most aggravating circumstances in connection with paving of city streets is that soon after the street has been well paved and the residents and property owners have begun to take personal pride in their new improvement, the

pavement is cut up to allow the placing of a pipe line or service connection to some new residence or store building. Progressive communities have grappled with this problem for many years but largely in vain. It has almost come to be taken for granted that a new pavement must be cut up soon after it has been finished, to allow these individual house connections to be made that could just as well have been placed before the pavement was laid, if the prospective builders had only given thought to it.

If a restriction were placed on this indiscriminate cutting up of new pavements by city authorities, this would undoubtedly have a restraining effect on these occurrences. It would cause prospective builders to lay their plans far enough in

-WARNING-
THIS STREET WILL BE PAVED -
All Underground Structures Gas and
Water Pipes, etc; Must be put in at once.
After Completion no permit to Cut
will be granted for Five Years.
HARRY L. DAVIS, MAYOR.

SIGN USED IN CLEVELAND, OHIO, TO WARN PUBLIC THAT EARLY CUTTING OF NEW PAVEMENT WILL NOT BE TOLERATED.

advance of such paving improvement to permit it being done before the pavement is placed. It would be an incentive to real estate owners to provide service connections at each one of their vacant lots in advance of pavement construction.

*Cleveland Method*

Cleveland, Ohio, has adopted this solution of this problem. Some time previous to the commencement of a paving improvement, signs are posted conspicuously along the street, giving notice of this work and requiring all underground connections to be placed before the paving is done. Thereafter the pavement must not be cut for this purpose for a period of five years.

Herewith is an illustration of one of their warning signs which clearly indicates their policy in this regard. This is a progressive development on the part of city officials to protect their pavements against the lack of forethought on the part of builders.

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## Present Status of Brick Pavements Constructed with Sand Cushions, Cement Mortar Beds and Green Concrete Foundation

*By Maj. Wm. M. Acheson, State Highway Department, Syracuse, N. Y.*

Brick pavement construction since 1915 has been subject to far greater changes in design than any other pavement. These changes, through a more rational use of the same amount of material, have tended to greater strength and durability. In this paper it is the intention to describe the three different types of pavement, or I might say the old and the new methods, and point out the advantages and disadvantages of each.

*Foundation Course*

The foundation course is usually made of cement concrete and in general a 1:2½:5 and 1:3:6 mixture is specified, the thickness depending largely upon the character of the subsoil and the amount of the traffic. While the cement concrete foundation predominates in brick pavement the construction of many miles has been laid on foundations of compact sand, gravel and broken stone. Engineers will agree with me in the absolute necessity and economy of concrete as a foundation for brick and all types of block wearing surface, together with mixed types of bituminous pavements. In fact, to my mind, the time is here when highway engineers are called upon to design rigid types of construction to meet the demand of modern traffic, which means the development of heavy motor driven traffic. Engineers are now giving special attention to the different parts of a pavement in order to meet existing conditions. Metal reinforcements is sometimes specified to be imbedded in the concrete foundation over soft places and recently dug trenches. By this it is hoped to prevent the cracking which in the majority of cases comes from the condition of the subsoil through the base to the surface of the pavement. Experience has shown that an evenly built foundation which conforms to the finished cross-section of the road, will result in a uniform thickness of sand cushion and a smooth wearing surface. In this pavement as in all other pavements the key to the whole situation is the condition of the subsoil and the foundation, and in this phase too great care cannot be exercised from the design or construction standpoint.

*Sand Cushion*

Brick pavements with a sand cushion or a bed course of plain sand have been built since the first brick pavement constructed in 1870 and represent at the present time by far the larger percentage of the three types. The thickness of the sand cushion called for in the older specifications in constructing this type of pavement has been considerably greater than advocated by most engineers at the present time. The theory advanced in behalf of the sand cushion is that it serves the double purpose of providing a uniform bearing for the wearing surface and supplies resiliency under traffic.

With this in mind specifications called for a sand bed not less than 2 ins. in thickness many of which were not given the proper care in constructing and were formed by screeding out the full thickness at one time without necessary consolidation by hand rolling. This was responsible for failures in the brick wearing surface which engineers traced directly to the non-uniformity of the sand bed. This was endeavored to be corrected in later specifications by calling for a sand cushion of not over 1 in. in thickness, together with requirements as to its gradation by sieve analysis and the amount of loam permissible in the sand used.

New York State specifications for the bed sand required a sand of which 100% passes a No. 6 sieve and not over 90% through a No. 20 sieve. "An excessively fine sand will not be accepted in this class. Sand may be rejected if it contains more than 15% of loam and silt," which amount was deemed advisable for proper compacting.

Present day specifications describe carefully the manner of forming or building up the sand bed by screeding it in layers and rolling the layers in order to form as nearly as possible a uniform bearing for the wearing surface.

Notwithstanding all the precautions and refinements of the later specifications where a sand bed is used, it has been shown that the defects were not overcome in the wearing surface, this being due to the fact that it is impossible properly to compact a sand bed varying in moisture content and thickness. Also a wet sand cushion when dried out will shrink and leave hollow spaces, consequently defeating its function of providing a firm and uniform bearing at all times for the wearing surface. Another defect of the sand cushion is that it works up into the joints of the brick and prevents the joint filler to penetrate thoroughly and bond properly the wearing

surface. In the repairing of many of our brick roads I have seen defects in the surface caused by the sand cushion coming up into the pavement at least 2½ ins.

*Wearing Surface*

The wearing surface of the pavement is composed of vitrified paving brick joined together with a filler. Smaller bricks were used in the early manufacture for brick pavements and without lugs. Later in order to obtain a uniform width of joint to take the filler the brick were made with lugs by repressing. The standard paving brick of today is 3½ ins. in width by 8½ ins. in length by 4 ins. in depth, laying 40 brick to the square yard. These brick are larger than the first brick manufactured.

*Wire-Cut Lug Brick*

The wire-cut lug brick came into vogue in 1910, the first wire-cut lug bricks being used by the New York State Commission of Highways in the construction of the Williamsville road near Buffalo. These brick have steadily increased in favor with paving engineers and are now universally called for. The experience of New York State with the wire-cut lug brick has been that it possesses uniform lugs and fiber sides, due to the method of manufacture. The fiber sides which are always obtained in a wire-cut brick give a greater bond strength at all times, while the uniform lugs insure a thorough and even penetration of the filler, and from a construction standpoint provide parallel joints, which means better construction. The square edge of a wire-cut brick in addition means a flush joint, which produces at all times a smooth wearing surface and one which will not cobble under traffic.

*Joint Fillers*

Two classes of joint filler are used to bond the brick units together, the cement grout filler and the bituminous filler. My experience and observation are that the results from the cement grout filler are superior and more durable than the soft filler and one which is absolutely necessary in modern semi-monolithic and monolithic types of construction. If soft filler is used the old sand bed is more likely to be the design. New York State specifications for cement grout filler allow the use of grout made of 1 part cement and 2 parts of grout sand, if machine mixed, and a grout made of 1 part Portland cement and 1 part grout sand if hand mixed. In general the specifications of today call for a grout made of 1 part cement to 1½ parts of sand. Machine mixed grout is, in the opinion of most paving engineers of today, far superior to hand mixed and at the same time is more economical in manipulating. Paving engineers recognize the necessity and importance of the grout filler and are taking every precaution in the selection of the materials and their application.

*Brick Pavements With Cement Sand Beds*

Experience and observation have demonstrated that many failures in the wearing surface are due to the sand cushion, which engineers have endeavored to combat. The solution of this factor has been the development of the cement sand bed which provided a non-shrinking, rigid super-foundation, thus making the first step toward a brick monolithic type of construction. Brick pavements constructed with a cement sand bed are commonly known as semi-monolithic construction and from this type developed the true brick monolithic construction which is now being used by highway engineers. The semi-monolithic type is the same as other brick pavements constructed with sand cushions, except that a mixture of sand and cement mixed in general 1 part Portland cement to 3 parts sand is substituted for the sand cushion. It is the practice to mix dry these materials thoroughly by machine in the proportions specified. The mixture when spread out should be screeded with a template cut to the required contour of the finished pavement. Care should be taken to get uniformity, but hand rolling is not deemed advisable as it has been learned that a rolled cement bed does not insure a smooth wearing surface due to its great density. With an unrolled surface the brick as laid is always bedded in the cement sand superfoundation. The thickness advocated in general is a minimum of ¾ in. and a maximum of 1 in. It is my practice to wet the cement sand bed with a sprinkling can just ahead of laying the brick. Immediately preceding the grouting the brick surface should be thoroughly wet.

*Semi-Monolithic Construction*

With present methods the semi-monolithic type of construction is better adapted to wide street construction than the monolithic. All precautions should be taken in the mixing and the application of the grout filler.

The advantages of semi-monolithic construction are that it overcomes the defects of the sand cushion by insuring rigid construction in that it practically unites the wearing surface with the concrete foundation. The cement sand cushion at all times provides a perfect bond for the full depth of the brick. This type eliminates the shrinking which is common in a sand cushion and at the same time eliminates the hollow or rumbling noise which is common with the sand cushion type of construction. It gives a more economic and scientific design in that it provides a stronger slab with the same material.

Brick pavements with cement sand beds were built in Baltimore as early as 1906 and adopted as their type of construction in 1915. The cement sand bed was used in Jacksonville in 1910 and also in connection with the paving of the ramps of the Pennsylvania Railroad terminal in New York in 1910. It has been demonstrated that shallow vitrified brick will stand up under heavy truck conditions when laid upon a cement sand bed. In this case fire clay brick 2¼ ins. in depth were used. This work in the Pennsylvania terminal demonstrates that in many places a block of less depth than the standard block can be economically used, and in fact, in the city of Syracuse an experiment was made by which a 3½ in. block was laid on a cement sand cushion with railroad tracks in the center on a street entering the city and satisfactory results have been obtained and I have in mind that the next pavement that we lay of this kind a 3 in. brick will be specified.

*Brick Pavements With Green Concrete Foundations*

This type of construction is commonly known as the monolithic type and is better adapted for highway construction up to say 24 ft. in width or where a templet may be used to shape the entire width of road at one time. It was first used in highway construction near Paris, Illinois. Proper consistency of the concrete foundation is essential for this type of construction. Care should be used in the proper spading and distributing of the concrete to prevent waves in the finished pavement due to possible difference in density. The concrete foundation is spread usually ½ in. high and formed by using a tamping templet which brings to the top a smooth mortar surface on which to bed the brick.

*A Power Templet*

For this purpose there has been developed a mechanical templet which consists of a gasoline engine mounted on a cross frame with wheels, which is carried on the side forms. This power templet performs the double purpose of tamping and smoothing the concrete and in addition compresses it to better density. This templet moves at the rate of 4 ft. a minute and can be adjusted to different widths. The laying of the brick wearing surface should follow closely on the concrete foundation and should be inspected, culled and rolled before the cement has its initial set. For rolling the wearing surface a hand roller is advocated about 30 ins. long, 24 ins. in diameter, weighing from 600 to 900 lbs. The rolling should follow immediately after the inspection so that the grout filler may be applied at once to secure the necessary bond with concrete foundation.

In this connection the so-called wire-cut lug brick is of special value in that it develops the full strength of the slab by reason of its superior side bond, due to its fiber sides, and

assures penetration of the bonding material to all parts of the joints due to its uniform lugs.

*Handling Grout Filler*

The mixing and placing of the grout filler is of the utmost importance for this type of construction as in the construction of brick pavements of the other types and the same precautions must be taken in the selection of the materials and their application.

All the advantages claimed for the semi-monolithic type of construction will hold for the brick pavements constructed on green concrete foundations to which may be mentioned the added increment of slab strength due to the more perfect bond of the wearing surface and the concrete foundation. This type also eliminates the use of edges in highway construction, which reduces the cost. The use of semi-monolithic and monolithic types have tended to develop the use of paving brick of less thickness which will result in economies, one of the most important being the saving in transportation charges. There should also be an economy in the first cost together with a saving in actual manipulation.

*Sand Cushion is Obsolete*

In my opinion the day of the sand cushion on rigid foundation is ended and the satisfactory type is a cement sand cushion for village and city streets, and that brick pavements for highways should be constructed on a green concrete foundation.

In closing I wish to emphasize the paramount importance of proper design of highways to take care of modern traffic. To my mind a rigid foundation is absolutely necessary on main trunk lines and where truck traffic predominates or may develop in the near future. The use of motor trucks for commercial purposes has grown tremendously and it is our duty to design highways which will be able to stand their loads up to reasonable limits and with reasonable maintenance charges.

The foregoing paper was presented at the 16th Annual Convention of the American Road Builders' Association, Feb. 25, 1919.

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## Some Points to Observe in the Construction of Concrete Roads

*By William W. Cox, Deputy State Highway Commissioner, Lansing, Mich.*

The construction of a concrete road appears very simple to the average person who has not made a thorough study and investigation into the essential details entering into the operation from start to finish. Adequate drainage, preparation of sub-grade, selection of materials, workmanship and protection, all have important bearing upon the desired results of obtaining a first-class concrete road.

*Adequate Drainage*

The all too common practice of placing concrete on a poorly drained grade cannot be condemned too strongly. Simply because of the bearing power or rigidity of concrete many are inclined to think that the presence of water in the subgrade does no particular harm. A concrete road so placed may show up very well for a short time, but sooner or later the action of frost and the result of heavily loaded vehicles will cause the concrete to crack badly and thus, eventually, result in complete failure of the road. It is, therefore, necessary first to provide good drainage so that the water level in the subgrade is at least 2 ft. below the concrete. All cracks or breaks, however, are not caused by inadequate drainage. Uneven settlement of the subgrade seems to be cause of the majority of the cracks which develop within a short time after the road is completed. It has been observed that where concrete roads have been built on new rights of way, where the entire grade was made new, very seldom any longitudinal cracks develop. Likewise, excellent results have been obtained in cases where the subgrade has been graded one year and the concrete placed the next. Also, longitudinal cracks in cuts are at a minimum where proper drainage has been provided. These results are conclusive proof that details of drainage and the detail in construction of the subgrade should not be omitted.

*Preparation of Subgrade*

It is well, likewise, that great care be exercised in the preparation of the subgrade so as to eliminate uneven settlement. To do this where narrow fills or turnpikes exist, they should be scarified, plowed and completely leveled and rolled to the full width of the grade before additional grading is done. The earth then should be placed over the full width, in layers not to exceed 1 ft. in thickness, each layer being thoroughly leveled and rolled. Whenever possible, if it does not seriously inconvenience the traveling public, it is recommended that the grading be done far in advance of the placing of concrete. Where light sand is encountered, watering heavily seems to be about the only method of securing satisfactory settlement; but if only spots of sand are found, it is best that the sand be removed and replaced with surrounding soil. In the final preparation of the subgrade prior to the placing of concrete or aggregate, care should be taken to see that it is true to form and to the proper elevations and that all loose earth is sprinkled and rolled. The placing of concrete or aggregate on loose earth or dust cannot be too strongly advised against.

*Coarse Aggregate*

The coarse aggregate should be either clean gravel or crushed stone.

Gravel should be composed of hard, clean, well graded pebbles, ranging in size from ¼ to 2 ins. Clay lumps, soft red sandstone or cemented pebbles cause surface defects, and therefore should be rejected. Properly graded gravel should be approximately as follows:

| | |
|---|---|
| Passing a 2-in. screen | 100% |
| Retained on a 1-in. screen, not less than | 25% |
| Passing a 1-in. screen, not less than | 25% |
| Retained on a ¼-in. screen, not less than | 95% |

If it is found impracticable to obtain such a grading of gravel, and another grading is used, it should be an even grade in respect to keeping the voids constant.

Crushed stone should be of good angular fracture even run in hardness, and when tested by the standard method should show a toughness of at least 8 and a French co-efficient of wear of not less than 10. Some of our limestone deposits, if handled with care, can be used for coarse aggregate. Crushed cobbles or field stone, when properly sorted, can in many localities be used to distinct advantage. Stone which, when crushed, spalls or pulverizes considerably, of course, should be sorted out.

In the selection of both crushed stone and gravel, coated or dirty material should be rejected, even though the percentage of clay or silt is comparatively small. The range in size, even run and percentage of voids for crushed stone, should be about the same as for gravel.

*Fine Aggregate*

Fine aggregate should be practically clean of silt, clay or loam and graded approximately as follows:

| | |
|---|---|
| Passing ¼-in. screen | 100% |
| Retained on No. 20 sieve, not more than | 60% |
| Retained on No. 20 sieve, not less than | 60% |
| Passing No. 50 sieve, not more than | 20% |

A coarser sand is recommended when used with crushed stone. Cement should meet the requirements of the standard specifications for Portland cement adopted by the American Society for Testing Materials in 1916.

Water should be free from oil, acid, alkali or vegetable matter and fairly free from clay or silt.

The batch mixer is considered the standard and should be so equipped that the number of revolutions for a given length of time can be easily obtained.

The forms should have a straight surface and should be set to a true grade and so thoroughly staked in place that no move-

ment can take place when concreting and finishing is being done.

*Mixing and Placing Concrete*

The amount of labor used in the laying of the concrete should be such that every detailed operation can be completed at the proper time and so that the whole is a steady progression. The more nearly the proportions of coarse and fine aggregates and the proportions of cement and the consistency of the batches can be made uniform, the more certain that the concrete when seasoned will give an even resistance to wear. The amount of water used in the mix should be just enough to insure that the mixer will completely discharge its batch to the conveyor. Concrete containing the proper amount of water requires considerable shoveling in place. Alternate dry and very wet patches will cause unequal shrinkage in the body of the concrete, and hence a wavy and unsatisfactory surface. More depressions are caused in the surface by the use of too much water than in any other way.

The subgrade should be well saturated before placing the concrete so as to avoid losing too much moisture before the finishing is complete.

*Finishing Concrete*

The finishing of the concrete, after being shoveled in place, should proceed immediately. It should be surface struck by a rigid template a few times over and then allowed to stand a few minutes until the surplus water comes to the top. The use of a roller of the Macon type has proven a great help in the finishing of the concrete surface. By its use, the excess water and air are brought to the surface, hence denser concrete is the result. Another great advantage in using the roller is that the ridges and depressions made by the template are entirely removed by rolling a few times. It should be operated, however, with care and judgment so as not to roll out the crown or make heavy depressions in the surface next to the forms. Although the split roller is used in bringing the concrete to the same height on both sides of the joint, nevertheless a split float and template should be used also. The rollers which seem to be the most satisfactory are about 15 in. in diameter, 5 ft. long and weigh about 75 lbs.

*Joints*

Cracks and joints are admitted to be the weak points of a well constructed concrete road, hence great care should be used in placing the joint and finishing the concrete adjacent to it. After a joint is placed and the striking of the concrete progresses towards the joint, there is usually an excess of concrete which has to be removed, hence considerable puddling and working of the concrete is necessary in order to have the surface true to cross-section. On the opposite side of the joint or at the beginning of the section, the striking of the concrete does not cause very much puddling, hence the shrinkage is considerably more and the result is a high and low side at the joint. It is, therefore, recommended that striking the concrete should proceed toward the joint enough so as to give about the same puddling effect on both sides. The joint should then be finished with a split float and template so as to finish both sides at the same height.

Because of the trouble encountered in finishing the open joint many authorities are now advocatitng the concealed joint which is placed so that the top of the joint is not more than ¼ in. below the surface. When concealed joints are used they should be held in place as near the surface as possible so that the joint filler will be forced out when the concrete seasons and expands.

*Belting*

After rolling is completed, the surface should be floated with a wooden float or belted to a rough finish. Considerable trouble is often encountered when belting is tried, due to the fact that inexperienced men attempt to belt when the surface is too wet, or attempt to belt too fast. It is rather difficult to describe the exact procedure in belting, or just when to belt, but both can be easily learned by perseverance and observation.

During hot weather or when evaporation is rapid, the surface should be protected by canvas until hard enough to permit sprinkling and covering with earth. Different combinations of aggregates, varying conditions of weather, and different brands of cement, as well as sub-soil conditions seem to cause concrete to behave much differently from other combinations. The mixing, placing and finishing of concrete made from crushed stone and sand are considerably different from those operations when gravel and sand are used.

The use of expansion joints is still a debatable question. The distance between joints varies considerably, but experience seems to indicate that a ½-inch joint every 50 ft. is adequate. Concrete which is laid in the fall seems to expand the following summer more than concrete which is laid during hot weather. Thus the concrete road question is a live and debatable subject.

Notwithstanding all the various points in view, I think we are safe in saying that 75% of failures and unsatisfactory results in concrete roads could be entirely eliminated if the essential details of good practice and construction were thoroughly observed.

The foregoing discussion is from a paper before the Michigan State Good Roads Association.

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## Some Suggestions on the Proper Construction of Granite Block Pavements

*By Albert T. Rhodes, Field Engineer, Granite Paving Block Manufacturers' Association of the U. S., 31 State Street, Boston, Mass.*

The production in the Northern granite quarries is entirely different from that in the South, due to the fact that the mass of granite has been constructed by nature in an entirely different manner from that in many of the Southern quarries.

*Procedure in Northern Quarries*

In the Northern quarries the granite is sub-divided by bed seams and other vertical seams, oftentimes the sheets piled layer after layer one on top of the other. The original mass containing the individual granite block is broken away by a series of small holes drilled for about 3 ins. on a line of fracture on which it is intended the stone to break. In these holes are placed what is known as shims and wedges, or plugs and feathers. Two shims are placed in a hole with a wedge between them—the shims tapering upward and the plugs tapering downward. When they are all in place the wedges are gradually driven down by a sledge hammer, little by little, exerting an enormous pressure upon the rock and finally rending it away from the original mass of stone in the quarry. Then the necessary dimension lines are laid out on the section so separated and the operation continued, after tracing a line with a chisel and hammer to indicate where the fracture of the block is to occur.

The peculiar thing about this tracing of the block is that although it does not cut into the stone to a depth of probably more than ⅛ in., still it seems to be enough to start an invisible fracture which the final break follows in almost every instance in a marvelous manner. The sub-division continues both vertically, and by turning the rock up, horizontally, until on some of the final breaks the stone is so small that by tracing on one side and turning the small cube of stone over, striking directly opposite the tracing with a stone hammer, the block separates finally into two individual blocks or halves. Any slight irregularities are trimmed off by a tool known as a reel, bringing the final product out in clean-cut lines with a variation in general of not over ⅜ in. from a straight line across the block.

*Old Hand Method of Producing Granite Blocks Still the Best*

It must be understood, naturally, that owing to the fact that granite paving blocks have been in use as a pavement in

this country for a very long period that very few radical changes or improvements in either the manufacture or laying of the material can now be brought about. There are several matters, however, which are of general interest to engineers and commissioners of public works, which are well worthy of consideration in the manufacture of the material itself.

It is understood that if any method could be devised whereby a paving block could be machine-made more quickly than it can be produced by hand, this method would be adopted; but the difficulty in handling the larger size original stone, which is gradually sub-divided in size down to that of the final finished paving block, is such that it does not lend itself readily to being placed in any machine constructed for this purpose. The continual decrease in size and the necessary handling of the product in its course of manufacture makes it extremely difficult to produce any machine which will do this work satisfactorily, consequently, the old hand method of production of granite blocks will probably continue for some time longer, although hope has not been given up that the proper labor saving machine may yet be produced.

When it is realized that the sub-division is made from a large block containing eight standard size paving blocks down to the final finished product of the standard block in 90 seconds, it can well be seen that a skillful mechanic can produce these stones with such readiness and can handle them by hand in their various sizes and shapes from the large rock, containing probably a cubic yard of material, down to the finished block, that it would be difficult to find any machine to handle the proposition much more economically for the reason that there would be considerable manual labor used in shifting the various sizes of blocks and the machine itself into position for cutting.

*Procedure in Southern Quarries*

In the South, owing to the fact that in many of the quarries the hills are one monolithic conglomerate mass, it is absolutely necessary, in order to separate the stone, that a bed seam should be obtained. This bed seam is created in an interesting manner. A hole is drilled down into the stone about 2 or 2½ in. in diameter. In the bottom of this hole a small charge of powder is exploded. This creates a small chamber and starts a seam extending out around the bottom of the hole. Into this hole a compressed air line from the quarry is introduced by iron pipe, which is plugged around the top and made absolutely tight against any leakage of the air under compression. Men are stationed at various points around the outside of the quarry and the signal is given. The air compressor begins its work—great groanings and wrenchings are heard from under foot, extending further and further away from the original drill hole where the air is introduced, until some one of the watchers on the outside circle observes a crack appearing, when the signal is given that all is over, for immediately upon release of the compression of the air through an outside point, naturally the compression becomes released and no further action can be expected from it. In this way several acres of the stone are raised at a time and the quarrying begins after a prependicular face has been produced, and is continued back until the bed seam runs out to nothing at the edge of the quarry.

VIEWS OF QUARRYING AND CUTTING OF GRANITE PAVING BLOCKS.
Top Row, Left: A Southern Quarry, a Monolithic Mass Without any Seams—Right: Northern Quarry with Bed Seams and Joint Planes. Bottom Row, Left: Cutting Blocks—Right: Breaking out Stock for Blocks.

It will be noted from the above statements that the production of the granite block is not in any way similar to the production of crushed stone, that no internal fracture or strain ever occurs in the inside of the final finished product, that granite has free lines of cleavage and a grain similar to that of wood, some stones from their nature, being finer of grain, split very freely and cleanly leaving smooth sides with no

bunches; other stones from their composition are coarse and show a rough exterior, but their value in either case is there and the traffic eventually wears them down to a smooth top and an easy riding street.

We have in my home city one of the earliest cement grouted granite pavements, in existence over 20 years, which today, so far as any visible wear is concerned, as compared to human life, would be just about ready to begin its kindergarten course. No more than the ordinary roughness has been smoothed from the stones and today its appearance is similar to that of a well troweled monolithic side-walk.

The reason why these same results are not uniformly obtained is because of the lack of proper paving, proper ramming and proper grouting. The municipality often gets 95% of what it pays for but the other 5% through ignorance, carelessness or absolute dishonesty so injures and spoils the 95% received that practically no value is obtained for the money paid.

*Hints on Proper Construction*

It is absolutely essential that each block be rammed home to a full and solid bearing. This must be done individually, by hand, and the skill and the eye of the rammer enters very materially into the appearance of the finished pavement. It is absolutely impossible to get proper results through any other method than the individual ramming of the stone because there is in each block more or less allowed and allowable variations in depth; and it will be seen that if a roller or any other device of that nature be operated over the pavement, only the deep blocks will be properly bedded home, the shallow ones not receiving the proper compression, the machine riding on the high, deep blocks. Each block showing too much settlement from the ramming should be taken out, not with pinch bars, but with a pair of paving tongs. The use of pinch bars would dislocate and disarrange all the surrounding blocks probably for several courses away. Upon the blocks being removed the necessary amount of bedding material is placed in the space and the block returned and rammed home to a proper bearing.

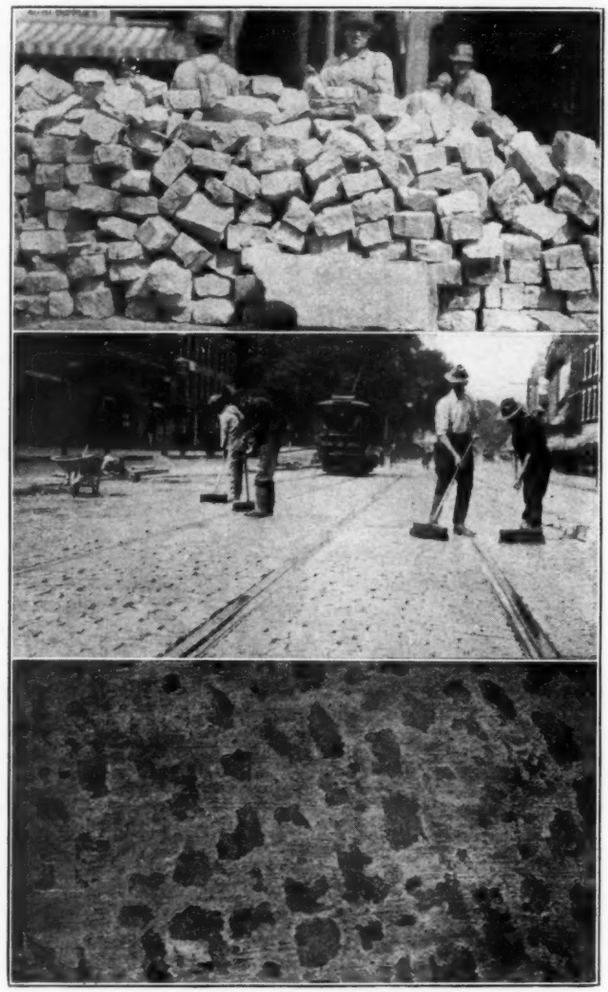
*Pea Stones in Joints Bad Practice*

It used to be the custom to use pea stone in the joints of the blocks in order, it was claimed, to steady the block and keep it upright in place. This particular feature has proved to be one of the most deterimental phases of the construction of the pavement in the past. Through ignorance, or carelessness, or dishonesty, the blocks would become filled to too great a depth with the pea stone, a collar of grout would be formed around the block with the entire bottom of the perpendicular joints filled with loose pea stone. The action of travel would tend through its impact from various directions to drive the block down, or sideways, or endways downward. The consequence was that through the pinching of the grout around the top of the block in this manner the top of the block would split loose, the body of the block being driven downward. It would then often be claimed by the person in charge, not familiar with the particular reason for this defect, that the blocks were soft. This idea of the necessity of pea stone in the ramming of the block has been thoroughly exploded, and today no difficulty is experienced in ramming the block dry and then filling the joint with a 1 to 1 grout from top to bottom. There then being no opportunity for a lateral or downward motion, the block being properly grouted and properly rammed, there can be no question that nothing but the impact or abrasion of travel can wear the top of the block off. This wear occurs in a very gradual manner and after a period of from 15 to 20 years the amount of wear on certain of our heavily travelled granite pavements, which have come under my observation, can hardly be measured in fractions of an inch.

*Proper Grout Mixture*

There has been much discussion in regard to what is the proper mixture for grout, but from an observation of hundreds of cases, and from samples taken up and in the writer's possession, there can be no question but what a 1 to 1 grout most nearly approximates the actual toughness and wear of the granite blocks which it surrounds. I have in my possession samples which have been down for 14 years in which the grout was allowed to cover over the top of the new block when it was laid, and this grout, after 14 years of wear, has only worn enough to show the top of the stone through in several places.

Naturally, the improvement and care in cutting is an advantage over the old style rough block which we used to be familiar with and which no doubt has given us our most vivid recollections in the past as a sample of what good granite



VIEWS ILLUSTRATING THE DURABILITY OF GRANITE PAVING BLOCKS.

Top: Blocks Removed after Fourteen Years' Wear to Permit Replacement of Street Rails Completely Worn Out. Center: Repaving Track Area with Blocks Shown in Top View. Bottom: Blocks laid for Thirty-six Years in Sand Joint and Relaid Five Years ago in 1:1 Cement Grout.

paving is *not*. Today the short, closely cut block makes a smooth, durable, easy riding pavement, agreeable to everybody and standing the most severe traffic which we are inflicting on pavements at the present day.

*Modern Adaptations of the Material*

In addition to the construction of the new pavement from this material, we have today several modern adaptations of the material giving extremely good results.

For the replacement of worn out pavements having a depth of approximately 4 ins., and in which the original concrete base is in good condition and still serviceable, there is being manufactured a type of block 3½ ins. in depth which recommends itself very highly to this type of construction and naturally the durability will be far in excess of any of the other types of pavement to which it succeeds.

The latest type of improved granite block paving which is being introduced because increased truck travel has made a demand for the most permanent type of trunk line highway construction may be briefly described as folows:

On a well compacted sub-grade, a cushion course of at least 1½ ins. after ramming of the pavement, of 1 to 3 dry cement mortar cushion should be placed. This may be slightly sprinkled in order to assist in the settling, and the blocks paved on this cushion course. After the blocks have been rammed the pavement should be sprinkled with water to assist in setting up the cushion course and also to bond more properly the 1 to 1 grouting, which is to follow, to the blocks themselves. This will produce a monolithic pavement from top to bottom, and compare favorably in cost with many of the other types of trunk line highway construction.

*For Standardized Blocks*

Much may be accomplished in the matter of the producers holding a good stock of material on hand if the engineer can be brought to realize that he gains no particular advantage by sticking to his "pet" size of block. The more the blocks are standardized the more readily will the producer have confidence in the ultimate consumption of any style of blocks which he may produce and hold in stock in his quarries. If the engineer will realize that in general there are schedules of sizes under which the paving cutters operate, under annual signed agreements, and any deviation from these sizes, in the way of special cut block, calls for an increased charge by the cutters as a special cut block, without in any way improving the quality of the work on which it is used, the standardization of sizes to not more than three or four different types will bring about the confidence of the producers in going ahead and making stock sizes, holding them in storage in quantities for immediate shipment, eliminating a great many of the delays which are often occasioned by the quarrymen having to produce sizes wanted after having received the order for the work.

*Bituminous Expansion Joint Strip at the Curb*

A bituminous expansion joint strip at the curb is coming into general practice performing two duties. It takes care of any lateral expansion across the street and also eliminates any continuance of vibration (if there be any) through the roadway pavement, to and through the curb and sidewalk to adjacent buildings.

*Protecting Green Cement Grout*

Through the common knowledge of the use of cement it is readily apparent that once the bond is broken between the grout and the granite paving block that no further union can be made to take effect between the stone and the mortar, consequently one of the most vital and essential things which can be instituted in favor and for the protection of the granite block pavement is proper barricading and proper policing. The cement in general takes its initial set in one-half an hour and should it be disturbed after that time the results are disastrous. Normally, also, the street will not be ready for opening to traffic inside of about six days, consequently during this time it is absolutely necessary to barricade the work. Proper barricades should in every case be erected and maintained during this period. Should there be a car track on the street on which the cars are operating, it is naturally almost impossible to protect the pavement to the full extent, unless it is policed by watchmen. All barricades have to be set back far enough from the rail so that the cars may pass and repass without striking them, and the traveling public through carelessness or ignorance often do a very considerable amount of damage by operating the wheels of vehicles outside of the car track area over the strip of freshly laid pavement. We do not believe that if the public really understood and had knowledge of the disastrous effects of their trespass upon the newly laid pavement that they would persist in actions so detrimental to the good results which their municipality will benefit from and a general campaign of education along these lines, even in the public schools, will do much in preserving for the tax payer the great results which he will obtain if the pavement is finally opened to traffic in proper condition.

*Use of Mortar Cushion*

The use of a mortar cushion, which, in the writer's opinion, should be of a 1 to 3 mix, to give it sufficient stability, is coming into general practice for use instead of the sand cushion under the blocks. This, naturally, is laid dry, sometimes sprinkled a little bit, and always sprinkled with a hose in advance of the grouting of the blocks. Naturally the blocks need to be rammed immediately after the laying, and the ramming kept up very close to the work of paving. The use of this mortar cushion accomplishes several purposes. It makes a more stable cushion if a block is not rammed to a full bearing on the cushion. It eliminates the disagreeable feature of the old sand cushion, where, after the paving was completely grouted often times the vibration of traffic on the top of the pavement would rattle the sand particles out of position in the bed, leaving the improperly rammed block suspended by the grout alone. Naturally, with the incorporation of the cement with the sand the setting of the cement itself holds the particles of sand in place under the block. It also tends to make a monolithic pavement from top to bottom.

*Use of Bituminous Mastic Filler*

The use of the bituminous mastic filler is more or less in its infancy, although it has been in practice for probably five years, superseding the old pebble and pitch type of joint filler. This construction is really very little known in the country as yet. It is probably more commonly used in New York City, Borough of Manhattan, than in any other district in the United States. It cannot be expected that this particular filler will show the durability of the cement grout filler, but circumstances alter cases, and to accomplish certain results this filler fills a long felt want. By the use of this filler a street may be opened to traffic probably six days earlier than where a cement grout filler is used. In addition to this as the mastic is ready for use immediately upon cooling, any accidental traffic happening to pass over the pavement immediately after it has been grouted would not have the injurious effect that it would upon a cement grouted pavement. Where the finished pavement is subject to many trench openings from time to time after being constructed, it is easier to open the paving if constructed in this manner; and naturally where the traffic is so active as it is in the downtown section of Manhattan, New York City, the saving of six days in the closing of a street means very much to the business conducted on that street.

There is another place where this bituminous mastic filler comes in to great advantage and that is on hillside work—giving the proper toehold for horses.

In general I do not think that the best results are being obtained at present in the matter of the bitumen which is used in this grouting, owing to several reasons. The necessary requirements for this joint filler are as follows: It must, and this is of utmost importance, have the quality of extreme fluidity so that it will flow readily to the bottom of the joints. It must have a high melting point so that it will not readily flow and soften in the summer sun, and should have a low penetration, extreme toughness and strong adhesiveness. Ask a contractor which he prefers to use of the two classes of bitumen and he will tell you he prefers to use one, but he thinks the other makes the best job. The greatest difficulty in this matter, to my mind, is that the tar and asphalt producers are in opposition in this matter. A good paving joint filler could be produced and marketed, made of a combination of the two materials, but neither is content unless the product is composed entirely of his own material.

The American Society for Municipal Improvements Specifications call, in the case of brick, for 40 to 60 per cent of sand and 60 to 40 per cent of bitumen. In the case of their granite block specifications the proportions called for are 35% to 50%

sand. There is no reason why the two should not be alike. I do not find that it is practical, in any event, to mix, without extreme care and fussiness, any mixture containing over 50% sand, nor is it conducive to the proper expediting of the work. The contractor's end of these matters has to be considered and what can be accomplished by energetic mixing in a laboratory is often impractical in the field.

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## Methods of Contracting for Highway Work During the Reconstruction Period

*By John H. Gordon, President New York State Road Builders Association, 25 N. Pearl St., Albany, N. Y.*

The generally accepted method of contracting for highway work throughout the United States is upon a lump sum bid, based upon unit prices of estimated quantities, the final settlement to be determined as a result of a final survey showing the actual amount of work done. As a rule the preliminary estimate and the final survey closely approximate, rarely is there any material difference.

This form of contract has its merits and demerits, every form of contract has, everything in the world has. It was found satisfactory in most cases until the war period. The contractors who found themselves with work taken at pre-war prices, had two alternatives, one—to abandon their work at the cost of their business existence, and the other alternative to complete the work at a great loss.

However well disposed a contractor may have been to have supported his own loss, the resources of many made this impossible, and we see in New York State forfeited contracts totaling on road work alone $5,000,000.

### *Present Prices*

And again, we are now at a point where a contractor will be called upon to hazard another guess as to the future. Engineers' estimates are the basis for the appropriation and in a measure regulate prices. It is the custom for engineers to base their estimates upon prices prevailing at the time the estimate is made, subject to subsequent alteration if any material change occurs between the date of the estimate and the date of the letting.

Today, prices have fallen but little from the highest, the matter of unskilled labor—the most important element in road contracting—is certainly undecided. Therefore, the contractor bidding today, if conservative must base his costs and bid upon the high, both in material and labor. Should there be a material decline between the day of the letting and the finishing of the work, the contractor will profit, just as the contractor lost under the conditions of rising prices after the beginning of the war.

### *Labor Shortage May Come*

It may be said that we have little occasion to enter into a discussion of this condition, inasmuch as the probabilities are strongly against further wars, or abnormal conditions produced by these wars, during this generation. But a similar situation, if not so extreme, may arise from other causes, great scarcity of labor being the principal one, and on which neither the contractor nor the state can make an entirely certain deduction.

But these remarks are made simply as an illustration of how extreme conditions may affect this form of contract. This form of contract is definite, the exact amount to be paid for the work specified is known. Should there be occasion to add to or subtract from the work, we have the unit prices to guide us. The terms are known, and there is little ground left for dispute. That it is a form in almost universal use for all kinds of construction is evidence of its merit.

### *Bonus and Penalty Feature*

There are some modifications of this form of contract. One is where the contractor makes an estimate of cost, and agrees to accept a definite fee, usually 10%, the collection of this fee depending upon accuracy of his estimate. Should the cost exceed his estimate, the contractor will lose, up to within 50% of his fee, the amount of this excess. Should the cost be less, the contractor will receive an additional payment of 50% of the saving.

### *Allowance for Price Fluctuations*

It is customary in some forms of lump sum contracts to state the cost price of material and labor used in making the estimate. In this form of contract the state or municipality pays an additional price on a rising market of material and labor, and is credited on a falling market.

There is something to be said in favor of both of these forms and they have their earnest advocates.

### *Disadvantages of the Cost Plus Contract*

Another form of contract used at times and in some states and municipalities, but not many, is the "cost plus" contract. Under this the contractor is paid for his time, knowledge and experience a fixed percentage based upon the cost of all the material and labor and rental of machinery that enter upon the completed work. Theoretically this would seem to be a very just form of contract, but actually no other form causes as many disputes and as much dissention. It is a trait of human nature that men will not work with the same vim and energy, will not husband their resources with as much care, will not be as solicitous for the prosecution of the work, where the costs are to be defrayed by the ample resources of the state or the municipality. However conscientious the contractor may be, he is unavoidably affected by this condition, and the men under him will not work for him in his position as quasi-superintendent for the state as well as they will work if they know it is a matter of dollars and cents to the contractor and that his vital interests are concerned. Moreover this form of contract has only too often led to scandal and adverse criticism, oftentimes unwarranted, but the general public is suspicious of collusion where there are no restraints more than can be prescribed under this form.

I know of no other methods of contracting in ordinary use. States and municipalities expend great sums in doing work under their own supervison, this is the most costly form of doing work that is known, and all records whether they be of state departments or municipal departments bear out this statement. No doubt it is necessary in small work and in small repairs for the state's forces to be employed, but the policy of engaging in work in a large way and with an expensive equipment is indefensible.

I have now briefly outlined methods of contracting for highway work that have heretofore prevailed. The title of my paper requires, or at least suggests, some recommendations as to the methods during this reconstruction period. It is very nearly impossible to offer any suggestions, lacking knowledge of what this period will produce, but I feel compelled to say that I see no method that will offer an improvement upon the lump sum bid form of contract. It is hazardous to the contractor, it has proved troublesome to the states on the forfeited contracts, although in these contracts they receive more than they pay, and it may prove somewhat more than ordinarily expensive on contracts during this period. Quick adjustments will be necessary, but I believe that the officers of the state can protect themselves so that the average will be just.

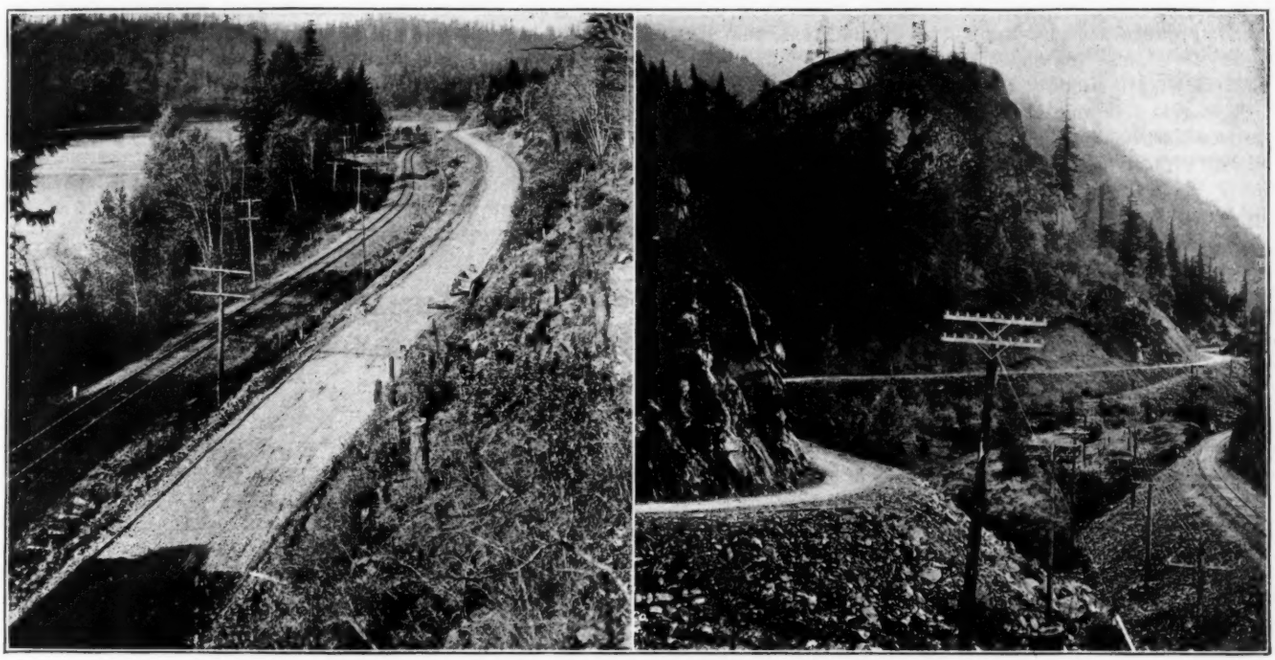
Perhaps the contractor in this reconstruction period will have more chance of making a large profit than of making a large loss, but that is not assured, no one can absolutely determine it or the bids to follow would be made in accordance with it. Every contractor knows that his business is a hazardous business. There is a gambling instinct in every man, those in whom it is most highly developed become contractors; most of them take losses and gains with a certain equanimity rather bewildering to men engaged in other lines. Every newspaper article that mentions a contractor speaks of him as a "rich contractor." Did you even know a rich contractor? There may be some, but there are only just about enough to make that exception which proves the rule. And yet, with all

the ups and downs, trials, tribulations and hardships, and uncertainties of bidding, I believe that in the reconstruction period and in all other periods, contractors would prefer to take their own chances as to the wisdom of their own judgment and the accuracy of their own figures, estimates and deductions.

The foregoing matter is the major portion of an address delivered at the 16th Annual Convention of the American Road Builders Association, Feb. 25, 1919.

## Five More States Report Their 1919 Road Plans

Twenty-five state highway engineers reported their plans for 1919 in the February number of Municipal and County Engineering (pp. 46-51). This article gives the plans of five additional states:



VIEWS OF IMPROVED HIGHWAYS IN THE STATE OF OREGON.

### *Florida*

Wm. F. Cocke, State Road Commissioner, submits the following data as to road and bridge construction work in Florida during 1919:

"Unfinished work to be completed this season: Bridges, 7; roads, sand-clay surface, 14 miles; macadam, 2 miles; bituminous, 2 miles; concrete, 7.5 miles; brick, 4.5 miles; asphalt, 29 miles; other types, 11 miles. Probable cost of work to be completed during 1919, $656,545.

"Contracts let but work not yet begun: Bridges, 1; roads, sand-clay, 35 miles; brick, 12 miles; other types, 6 miles. Probable cost, $360,000.

"Work ready for contract or force account: Bridges, 4; roads, grading or earth, 22 miles; sand-clay, 24 miles; macadam, 20 miles; bituminous, 3 miles; other types, 5 miles. Probable cost, $283,000.

"Contemplated work, not included in above: Bridges, 2; roads, grading or earth, 12 miles; sand-clay, 8 miles; macadam, 10 miles; concrete, 15 miles; brick, 36 miles; asphalt, 42 miles; other types, 10 miles. Probable cost, $919,000.

"Total probable amount of work in State *not* under supervision of State Road Department:

"Construction, 414 miles; probable cost, $2,895,800. Maintenance, 11,070 miles; probable cost, $885,600.

"Total probable amount of maintenance work by or under State Road Department, 2,340 miles; probable cost, $280,000.

"Grand total road and bridge approximate expenditures will be from: State, $798,334; Local, $4,622,339; Federal, $859,272. Total, $6,279,945."

### *Ohio*

H. D. Brunning, Chief Highway Engineer, Columbus, submits the tabulation herewith showing the proposed road and bridge work for the season of 1919 in the State of Ohio under the supervision of the State Highway Department.

### *Oregon*

Roy A. Klein, Secretary Oregon State Highway Commission, Salem, submits the following statement covering highway construction in Oregon for the year 1919.

"The Oregon Legislature has passed a highway bonding bill which provides for $10,000,000 in highway bonds to be issued during the next five years. In addition to this sum, there is a balance of $3,500,000 yet to be expended, proceeds from the

PROPOSED ROAD AND BRIDGE WORK IN MISSOURI FOR SEASON 1919

Construction work under State Highway Department.

| | Types, Mileage | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bridges Number | Grading or Earth | Sand Clay | Gravel | Macadam | Bituminous | Conc. | Brick | Asphalt | Other Types | Probable cost of work to be completed during 1919 |
| Unfinished work to be completed this season | 16 | 176 | ... | 381 | 34.2 | 13 | 7.4 | ... | ... | 54.9 | $1,785,100* |
| Contracts let but work not yet begun | .. | ... | ... | ... | ... | ... | ... | ... | ... | ... | ..... |
| Work ready for contract or force account | 95 | 521 | ... | 293 | 7.8 | 30.5 | 15.9 | 9.7 | 3.7 | 7.6 | 3,104,000 |
| Any contemplated work not included in above | .. | Estimate for 1919 not yet classified. | | | | | | | | | 3,000,000 |

Total probable amount of road work in state not under supervision of State Highway Department: †Construction, $3,000,000; maintenance, $4,000,000.

Total probable amount of maintenance work by or under State Highway Department, $200,000 (Drag), 11,000 miles.

Grand total road and bridge expenditures will be from state, local and federal funds in the following approximate amounts: State, $2,300,000; local, $7,000,000; federal, $800,000.

*Note: $220,000 of this amount expended in 1918. †Note: Based on road and bridge tax levy †Note: Chat and Oil.

PROPOSED ROAD AND BRIDGE WORK IN OHIO FOR SEASON OF 1919

Construction work under State Highway Department — Types Mileage

| | Bridges Number | Grading or Earth | Sand Clay | Gravel | Macadam | Bituminous | Concrete | Brick | Asphalt | Other Types† | Probable cost of work to be completed during 1919 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unfinished work to be completed this season | 1 | 5.59 | ... | 0.85 | 46.48 | 24.71 | 33.56 | 35.44 | ... | ... | $ 2,853,372 |
| Contracts let but work not yet begun | 2 | ... | ... | ... | 10.05 | 16.79 | 6.78 | 8.42 | ... | ... | 1,017,576 |
| Work ready for contract or force account | 3 | 2.04 | ... | ... | 1.36 | 1.49 | 1.10 | 12.90 | ... | ... | 1,026,150 |
| Any contemplated work not included in above | .. | Not determined. | | | | | | | | | 14,000,000 |

Total probable amount of road construction and maintenance work in state not under supervision of State Highway Department not known.

Total probable amount of maintenance work under State Highway Department: Miles, 3,000; $2,300,000.

Grand total road and bridge expenditures under supervision of State Highway Department will be from state, local and federal funds in the following approximate amount: State, $7,600,000; local, $13,400,000; federal, $1,680,000.

legislative act of 1917. A large part of these bonds will be expended for hard surfacing state highways.

"To provide for the payment of the principal and interest on these bonds, as well as for funds available for highway construction, the Legislature has placed a tax of 1c. per gallon on gasoline and ½c. per gallon on distillate, which it is estimated will produce $400,000 annually. In addition, the present automobile license fee has been practically doubled, which it is estimated will produce $1,500,000 per year.

"Under the original Federal Aid Road Act, the state will receive $1,180,000 from the Federal Government for post roads and $698,970 for forest roads, which will be matched with state funds. If the new Federal Aid law goes into effect, Oregon will benefit to the extent of $3,149,000 for post roads, and for forest roads, $1,150,000, in addition to the funds now provided by the Federal Aid Road Act of 1916.

"A tax of one-quarter mill on the assessed valuation of the state is also available for highway purposes.

"The State of Oregon has nearly 40,000 miles of public roads. About one-tenth of this amount is included in the state highway system. Out of this total, there has been laid to date, exclusive of city pavements, 38 miles of cement concrete pavement and 187 miles of asphaltic concrete pavement. There is a large mileage, however, of plank, broken stone and gravel roads.

"It is expected that the State Highway Commission will expend practically $6,000,000 this year and various counties in the state will probably spend an equal amount on the county roads. The Pacific Highway is the first highway in importance in the state, running, as it does, north and south, throughout the length of the state. Next is the Columbia River Highway, which follows the Columbia river from the eastern part of the state all the way to the sea.

"During the years 1917 and 1918 the work was greatly curtailed on account of war activities and the shortage of labor and materials. The labor situation is now much easier and materials and supplies of all kinds may be obtained, so that it is expected the year 1919 will be a banner year in highway construction in this state. The Highway Commission is endeavoring to start work at an early date and has already awarded 15 contracts totaling about $1,500,000, and more will be awarded each month until the entire program is covered."

*Minnesota*

John H. Mullen, Deputy Commissioner of Highways, St. Paul, writes:

"The layout of work in the various counties in this state has not yet been completed (Feb. 1.) However, we have complete reports from 28 counties, in which there is proposed 432 miles of grading. We have also Federal Aid projects in 13 counties, aggregating 208 miles of grading and surfacing at an estimated cost of $1,294,000. Of this there will be 22 miles of hard surfacing.

"The total funds available in Minnesota for this year are as follows:

| | |
|---|---|
| State Road and Bridge Fund | $1,980,000 |
| County Road and Bridge Fund | 5,398,000 |
| Federal Aid | 568,309 |
| Total | $7,946,309 |

"It is expected that the year 1919 will be a banner year in road construction in this state and present indications are that the only limit on work to be done will be the available labor."

*Missouri*

C. W. Brown, Chief Clerk, State Highway Department, submits the accompanying tabulation of proposed road and bridge work in Missouri for the season of 1919.

## More City Engineers Tell of Public Works Plans

Many important letters telling of public works construction projects planned to provide buffer employment for labor during the readjustment period were published on pp. 37-46 of Municipal and County Engineering for February. The present article gives additional information of the same character:

*Baltimore, Md.*

Milton J. Ruark, Division Engineer of Sewers, submits the accompanying tabulation regarding the proposed construction of the sewer department of Baltimore, showing the funds included in the annual appropriation for the maintenance and operation of the sewerage system. He writes:

"The Sewer Division is connected with the Highways Department and the following figures do not include any appropriation for auditing and book-keeping or transportation, hauling and the maintenance of storage yards, which is taken out of the general funds of the Highways Department.

The Sewer Division of the Highways Department also does considerable construction for private parties, railroads and corporations. It also installs and extends storm water drains in advance of the operation of the Paving Commission, and the cost of such construction is provided from funds available for paving and improvements. As near as can be estimated at this time, the value of such miscellaneous work will amount to $200,000 or $300,000 for the year 1919.

| | |
|---|---|
| Maintenance and Improvement of Sanitary and Storm Water Systems | $ 75,000 |
| Maintenance and Operation of Sewage Disposal Works | 51,250 |
| Maintenance and Operation of Sewage Pumping Station | 59,160 |
| Sewer planning (to be expended only upon written order of the Board of Estimates) | 5,000 |
| 400 H. P. Boiler completely installed at Sewage Pumping Station | 17,000 |
| Pipe work for 400 H. P. Boiler at Sewage Pumping Station | 500 |
| 400 H. P. stoker completely installed at Sewage Pumping Station | 4,500 |
| Three 260 H. P. stokers completely installed at Sewage Pumping Station | 8,600 |
| Screening press at Sewage Pumping Station | 2,000 |
| Maintenance and extension of storm water and sanitary sewers | 100,000 |
| Locust Point Sanitary Interceptor (to be expended only under direction of the Board of Estimates) | 33,326 |
| Improvements to Lakewood Avenue drain (new concrete invert for old 24' storm water drain) | 10,000 |
| New sludge digestive tank at Disposal Works (Back River Plant) | 10,000 |

Maintenance and improvement of sanitary and storm water systems (New Addition) ..... 5,000

*Public Works Department, Boston, Mass.*

T. F. Sullivan, Commissioner of Public Works, writes:

"It is proposed to spend $1,000,000 in the construction of sewers and surface drains in Brighton, West Roxbury, Dorchester, Hyde Park, East Boston, and the City Proper during the coming season. These proposed sewers and surface drains will vary in size from 12 in. pipe sewer to 10 ft. circular concrete conduit.

"In the Highway Division it is proposed to widen and reconstruct streets at an estimated cost of about $1,100,000. In adition to this, we have an unused appropriation from last year of $850,000 for the repaving of main traffic thoroughfares; also we propose to spend about $1,000,000 additional in the repaving of other streets.

"In the Water Division it is proposed to spend about $1,000,000 for maintenance and construction.

"In the Bridge Service it is proposed to spend about $600,000 for the reconstruction and repair of bridges, and plans have been prepared for the construction of a sea wall bulkhead in the Roxbury Canal, at an estimated cost of $202,000.

"In the Ferry Service it is proposed to expend about $110,000 for extraordinary repairs involving the reconstruction of ferry boats, repairs to drops, etc."

*Memphis Tenn.*

H. H. Hull, City Engineer, writes:

"We have not yet prepared our budget for the ensuing year but are working on it and hope to have our plans fully outlined within the next 30 days (about April 1.) It may be safely stated, though, that the city will, during this year, expend from two to five hundred thousand dollars on street repair and improvements. Our streets are in fair condition considering the obstacles that we have had to overcome in securing material and labor, but at the same time there is a great deal of work to be done and I am satisfied the Commission is cognizant of the fact that heroic steps must be taken to get the streets back into their normal condition.

"It may be interesting for you to know that the City of Memphis and the County of Shelby jointly propose the construction this year of an auditorium building to cost approximately $750,000. Bonds for same will be offered for sale on the 25th of March.

"I am sure that you can safely state that Memphis will keep abreast of the times and will not be lax in endeavoring to do all that is possible in promoting and executing work so as to join with the other municipalities in assisting to have conditions return to normal."

*Yakima, Washington*

Orpheus C. Soots, Executive Secretary of the Yakima Commercial Club, writes:

"We agree with you that times will be just as good as we make them. The Yakima Commercial Club, realizing that needed building operations of all kinds should be started without delay, has launched a building campaign which is already meeting with very satisfactory results. Nearly half a million dollars worth of road construction will be carried on in this county within the next few months, contracts for which have already been let. The municipality is also planning on a large program of development in the way of sewer extensions, paving, sidewalk building, etc., in the city. Numerous residences, warehouses, and two or three business blocks are being planned for early construction."

*Harrisburg, Pa.*

M. B. Cowden, City Engineer, writes:

"The late war has certainly put Harrisburg in a bad position as far as doing any new work in this city, this year, is concerned. We will probably pave 10,000 yards of streets with sheet asphalt, and construct $5,000 worth of sewers, and in repairing streets $30,000 will certainly be spent.

"We have a loan to put before the people for paving intersections and non-assessable properties, but it will not be available until 1920.

"If, in letting the 10,000 yds. spoken of, we do not find the prices too high, in all probability we will do at least 10,000 yds. more of paving, and double the sewerage work.

"The State of Pennsylvania is contemplating the building of the State street overhead bridge which will cost $2,000,000; and various improvements in what is known as Capital Park Extension Zone."

*Binghamton, N. Y.*

W. Earl Weller, City Engineer, writes:

"The City of Binghamton proposes to expend during the coming season about $60,000 on the construction of small sewers, about $25,000 on permanent creek protection and about $40,000 on penetration macadam roads. The above work is practically certain. There is also a considerable amount of potential work but it is extremely difficult to awaken the taxpayers to the advisability of proceeding with this work at the present time. I believe that the Federal Government acting through the Department of Labor should inform itself regarding all potential public works and then, by sending representatives to the various cities lend the weight of the National Government to secure the early adoption of the legal steps to make the necessary work possible."

*Brockton, Mass.*

Harold S. Crocker, City Engineer, writes:

"The City of Brockton, through its Highway Commissioners, will build 13,700 yds. of block paving, and a possibility of building 5,500 yds. more; 5,500 yds. of concrete road; 37,500 yds. of asphalt macadam (penetration method), with a possibility of 50,000 additional yards.

"The drainage work contemplated consists of 1½ miles of stream to be straightened, widened and deepened, below the city limits; and they also have $10,000 with which to build small pipe drains, culverts, etc.

"The Sewer department expects to lay about two miles of street sewers.

In addition to the street surfaces, about 4,000 ft. of curb and gutter will probably be laid, and also about 6,000 sq. yds. of granolithic sidewalk."

*Fall River, Mass.*

Albert Wolstenholme, City Engineer, writes:

"In answer to your inquiry of January 17, would say that 'No definite schemes of improvement have yet been decided upon in this city.'

"There is a very strong feeling, however, that notwithstanding the high cost of materials and labor, work of a public nature should be pushed to help bridge over the unsettled period that has come as a result of the cessation of war activities.

"In this city the work will be surely in the line of increased sewer and street construction, and some other prospects are talked of but have not yet assumed definite shape."

*Waterbury, Conn.*

R. A. Cairns, City Engineer, writes:

"Much work is contemplated by the city, but none has been definitely ordered. It is expected that three or four fire engine houses, one or more school houses and some smaller buildings, such as department garages, etc., will be built this year. A bond issue of $500,000 is intended for street improvement work, largely paving. This is reasonably certain. There will also probably be a $3,000,000 bond issue for reservoir and pipe line."

*Waterloo, Iowa*

G. H. Kilpatrick, Asst. City Engineer, writes:

"The City of Waterloo contemplates some public work the coming season and the following is being considered:

"A steel reinforced concrete 5-span bridge across the Cedar River between Cedar River park and Sans Souci park.

"There is at present under consideration 95,000 sq. yds. asphalt paving, 19,273 sq. yds. of asphalt paving to be re-

surfaced, 48,400 lin. ft. of combined concrete curb and gutter, 8,665 lin. ft. of combined sewer and approximately 3 miles of cement sidewalks 5 ft., 4 ins. wide.

"The River Front Commission will build about 500 ft. of sea wall but as no plan has been decided upon at this time, very little of a definite nature can be given."

*Battle Creek, Mich.*

Edward Hoyt, Asst. Engineer, writes:

"It is proposed to construct about 45,000 sq. yds. asphaltic concrete pavement and about 8,000 sq. yds. of brick pavement. We will also construct one reinforced cement arch bridge over the Battle Creek river at Emmett St. In addition to the above we will construct the usual amount of curbing, sidewalks and sewers but am unable at this time to give any stated amount."

*Jackson, Miss.*

M. L. Culley, City Engineer, writes:

"No new construction work is proposed for 1919, except the repairing of about 15,000 yds. of street paving, probably resurfacing the old brick and asphalt pavement with sheet asphalt. Shortage of funds prevents any extensive construction program."

*Flint, Mich.*

Ezra C. Shoecraft, City Engineer, writes:

"We will do the following work in this city during the coming season: 105,000 sq. yds. of pavements, estimated cost, $350,000; 15 miles of sanitary and storm water sewers, estimated cost, $350,000; 400,000 sq. ft. of sidewalks; 1 reinforced concrete arch bridge; 20 miles of water mains."

*Cedar Rapids, Ia.*

T. F. McCauley, City Engineer, writes:

"Our certainties are three miles of 5 ft. cement walk and about ½ mile of sanitary sewers. An almost assured project is a concrete bridge across the Cedar river that will cost approximately $250,000, and we also contemplate the construction of $150,000 worth of concrete storm sewers."

*Port Huron, Mich.*

Earl Whitmore, City Engineer, writes:

"Our program for 1919 calls for quite extensive street improvements, but has not yet been definitely determined.

"The following are quite certain of construction: Lapeer Ave. from 16th to 24th Sts., 28ft. wide brick or concrete, Twenty-Second and Railroad Sts., about 8 blocks 28 ft. wide, brick or concrete.

"In addition to these two streets the following are under consideration with a good prospect that a considerable portion of them will be built:

"Pine Grove Ave., about ¾ mile long, 18 ft. wide, concrete; Stone St. and Garfield St., 9 blocks long, brick or concrete; Scott Ave., 7 blocks long; Tenth Ave., 11 blocks long; Michigan St., 6 blocks long; Park St., 4 blocks long; Commercial St., 1 block long; Crescent Place, 2 blocks long; Pine St., 10 blocks long; Fourth St., 5 blocks long; Jenkinson St., 1 block long. Also an alley or two.

"This paving, except as otherwise stated, will average about 30 ft. in width and probably a good deal of it will not be built this season. We should know within three or four weeks (by April 1) quite definitely, which streets will be built."

*Aberdeen, S. Dak.*

Frank LeCocq, City Engineer, writes:

"Plans about completed for $300,000.00 storm sewer system. Bond issue to be voted on next April. It looks as if it will go thru. Sewer from 18 ins. to 9. ft. in diameter."

*Asheville, N. C.*

B. M. Lee, City Engineer, writes:

"The City of Asheville, N. C., have so far ordered the following work to begin in the spring: Street paving, Durax, 13,900 yds.; street paving, concrete, 26,830 yds.; sidewalks, cement, 13,000 yds.

"Will probably order other work later but I cannot tell the amount."

*Eldorado, Kans.*

Bert C. Wells, City Manager, writes:

"We will probably pave about 40 blocks, 50,000 sq. yds. Will build some sewers, amounting to approximately $50,000. Will lay a large quantity of sidewalk.

"A large number of buildings are being planned for this summer."

*Pueblo, Colo.*

D. P. Gaymon, City Engineer, writes as follows regarding proposed municipal improvements for 1919 in Pueblo:

"The reasonably certain work to begin and complete by Nov. 15, 1919, will be two paving jobs, the specifications for which we have just completed. One district will be 40,500 sq. yds. of bitulithic on crushed rock base, with 18,000 ft. of combined concrete curb and gutter, and a $9,500 sewer job.

"The other job of pavement will be 27,100 sq. yds. bitulithic pavement, laid on a concrete base, 11,600 ft. of combined concrete curb and gutter, $3,500 in storm sewer.

"The city authorities are certainly in favor of all work that is designed to act as a safety valve for the high pressure at present developing in the field of labor."

*Twin Falls, Ida.*

E. V. Berg, City Engineer, gives the following data on work in Twin Falls, including pavement, sewer and bridge:

"The location of the pavement is largely in the residence district though a number of alleys in the business section will also be paved. There will be approximately 6 miles of first grade pavement such as asphalt, bitulithic or concrete and in the bituminous macadam class. The total amount of pavement work which it is contemplated doing is in the neighborhood of 200,000 sq. yds. Bonds have not yet been voted for this improvement but there is no serious opposition anticipated. The total cost of this work will run in the neighborhood of $600,000.

"The city also expects to add a new trunk line to its sewer system, as well as several lateral sewer districts. A string of additions have been added to the city on the north and east sides in recent years and it has become necessary to provide these districts with a main trunk line. The cost of this improvement will be about $40,000.

"The matter of replacing the wood trestle across Rock Creek, within the city limits, with a steel bridge has also been considered and if not done this summer will surely be done within the next year or two. This bridge at the present time would cost in the neighborhood of $75,000."

## Newspaper in Strong Plea for Permanent Highways

That the newspapers of the country are becoming convinced of the unwisdom of building temporary roads is accurately reflected in the following editorial from a recent issue of the Valdosta Times, of Valdosta, Lowndes County, Ga.:

Lowndes county, last year, spent between $40,000 and $50,000 on public roads. Most of it was contribution to the sand-swapping process which has gone on under the good roads idea for several years. We admit that it was better work than was formerly done. It is a movement in the right direction. Many of the roads were straightened and graded, the wet places filled-in and the sand beds were buried. The roads we have now would have filled our hearts with joy 25 years ago. when a trip from Valdosta to Hahira was about a Sabbath day's journey. A man who lived 25 miles away had to bring his camping outfit with him and return home about the third day after leaving.

But that was in the long ago. It was before the advent of the automobile, the motor-plow and the farm truck. It was in an age when time did not count for much. The wear and tear of vehicles and horses were not figured in the expenses of the farm. The increased value of land as a result of good roads was no incentive, as most land-owners wanted to buy more land and let it remain in idleness or only partially cultivated. Everything was different then from what it is now. The sandy trails through the woods were the only roads we had or

thought about. To make them clear of roots and stumps was our idea of good roads. We have progressed since then. We have been climbing upward all the time. First, it was the "potato ridge roads" then followed the "burial of sandbeds." Then came the sand-clay roads and later the graded, straightened, 30-ft. highways which do good service when the weather remains good and the roads are worked.

But these roads are only a beginning. They are just good enough to make us want permanent roads—roads that will stand all sorts of weather and which will not be in need of constant repair. Such roads will cost money, but no more than we are wasting every year on roads that are not permanent. The $46,000 we spend annually on sand-clay roads would pay the interest on more than a million dollars worth of bonds for permanent work. Or, if we had started putting $25,000 a year in permanent roads ten years ago we would have had $250,000 worth of paved roads by now. We would have had the nucleus of a system of public highways that would have made Lowndes county one of the greatest counties in the state.

It is time that we were spending our money on roads that the first shower will not make impassable. A million dollars in bonds would bring many millions of increase in values to this county. It would put the cost of roads upon posterity, which is to enjoy the advantage of such an expenditure. It would cut down the amount of time lost jogging along the washed out roads and would also save an untold amount of loss from wear-and-tear on vehicles of every kind. It would enable the farmer to get to market quicker and carry much larger loads on his wagon. It would help all of the communities of the county, adding to the value of property and increasing the desirability of rural homes. It would impose no burden upon anybody. We would never know that there was a bonded indebtedness hanging over the county. We are hopeful that Lowndes will become interested in permanent roads and that the people will not rest until they get them.

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## Design and Constructional Features of the Baraga Road in Baraga County, Michigan

*By G. C. Dillman, District Engineer, Michigan State Highway Department, Escanaba, Mich.*

The road situation in Baraga county up to a few months ago was as follows:

The equalized valuation of Baraga county is $5,600,000 with an allowed trunk line mileage of 75.6 miles. From this we have the valuation per trunk line mile of but $74,074, which is one of the lowest in the upper peninsula of Michigan.

To the north and west of Baraga county are the great copper mines. On the east and south are the iron ranges. These mining counties, with an abundance of improved highways completed in most part to the Baraga line, had no connecting road other than the "bump-providing, rough-on-riding" roads of Baraga.

As a result there had been considerable condemnation of these roads by the traveling public, some of which was not warranted. The main connecting road lay through an exceedingly rough country, there being many excessive grades and dangerous turns. The county though working under the county road system, had neither organization nor money to spend. Hence, the outlook for an improved road across the county looked rather distant.

In the fall of 1916, after federal aid was assured, State Highway Commissioner Rogers called a meeting at Marquette and proposed to place considerable of the upper peninsula portion of this money in Baraga county. Representatives of nearly all the upper peninsula counties were present at this meeting and most of them were in accord with the proposition.

In the meantime, a survey had been ordered made for a road across Baraga county which was completed in the early winter of 1916-1917. Then, with the necessary constitutional amendment, the 1917 Legislature provided for the construction, maintenance and improvement of federal aid roads.

Thus, with Federal and State aid in sight the county bonded for $110,000 to meet its portion of the cost of building this road. The original estimate of cost was $417,080.40, the county being called upon to pay, in this case 25 per cent., or $104,270.10. The estimate does not include the cost of building five concrete and steel bridges.

*Federal Aid Road No. 3*

This road, known as Federal Aid Road No. 3, commences at the south line of Houghton county, extending in a southerly and easterly direction to Michigamme, on the west line of Marquette county, a distance of 48¼ miles.

The present project includes grading, building of all drainage structures and laying of ¾ mile of cement concrete pavement in each of the villages of L'Anse and Baraga. When this is done the balance of the road will be surfaced with stamp sand and gravel. In the meantime the new grade will be kept in reasonably good condition for travel.

For convenience the road was divided into four sections, namely, A, B, C, and D. Contract for the whole was let April 16, 1918. The Smith-Sparks Construction Company of Houghton were given the contract for sections A and B, a distance of 19.2 miles. M. J. Bacco of Iron Mountain was awarded sections C and D, 29 miles in length. All work is to be completed by Jan. 1, 1920.

*Section A*

Section A extended from the Houghton county line south to station 614 + 30, a distance of 11.6 miles. The new survey holds fairly close to the old road, the only changes being made to improve the alignment and to get better railroad crossings. There is no deflection whatever in the north five miles as this is an old base line.

The predominating soil is clay with occasional sand areas. There is 850 ft. of 7 per cent. grade at Keweenaw Bay which could not be avoided due to there being two railroad crossings at the upper end, with a lighter grade continuing for another 1,500 ft. This grade is all in fill varying from 2 to 7 ft. and was made with stamp sand obtained locally. Making embankments with stamp sand where it is available has not been the general practice, yet we had excellent results.

Stamp sand is composed of small particles of copper-bearing rock, stamped to sizes varying from silt to ⅛ in. generally cubical, from which the metallic copper has been washed. The rock is similar to diabese and trap.

The heaviest work on this section was the cutting down of "Fuseville" hill to 6 per cent. grades. This was mostly a side hill cut and meant the moving of 10,000 cu. yds. of dirt. To take care of traffic it was necessary to "step" down the cut which slowed up the work somewhat, yet with Maneys and drag scrapers good progress was made.

This section takes you along the old Indian Mission at Assinnius and follows close to Keweenaw Bay the entire distance.

The surfacing will be two-course stamp sand, the construction being similar to ordinary sand-clay work.

*Section B*

Section B extends from station 614 + 30 to station 1014 + 00, a distance of 7.6 miles. This too, mainly follows the old road.

Seventy stations lie at the edge of Keweenaw Bay, requiring 15,000 cu. yds. of fill to put the road bed sufficiently above high water. This is an overhaul job, the average overhaul distance being 3,200 ft. Cars and track will be used, the dirt being loaded with a steam shovel. Considerable of the fill on the bay side will need rip rap, field stone and ledge being taken from the road side north of Baraga to be used for the purpose.

The road crosses a bayou where an 84 ft. steel truss bridge is being built. At one place in the channel the water is 45 ft. deep. At times the flow in the channel is in one way, at others

in the opposite direction. Long, straight abutments without wing walls were built on piles, the plan being to surround the piles with stone and rip rap the backfill heavily.

Probably the most difficult construction on this section will be that of building the road along a sand stone bluff north of L'Anse. The bluff rises 20 ft. or more vertical on the west side, on the east the bay being 20 ft. below. The South Shore Railroad is at the upper edge of this bluff, hence we could not cut further into the rock, so will build 700 ft. of concrete retaining wall to enable us to get the full grade width. This will be a plain gravity section, 10 ft. high and 6 ft. on the base. A trench will be blasted into the rock underlying the bay to insure a good footing for the wall.

As stated before, three-quarters of a mile of cement concrete pavement will be laid in each of the villages of L'Anse and Baraga. In L'Asne there is 550 ft. of 8 per cent. grade on which concrete will be laid. This is on a residence street and to get this grade it required a maximum cut of 8.5 ft. at the center. Then a village water main was uncovered which had to be lowered at a cost of about $1,000.

Concrete curb and gutter will be built adjacent to the pavement on this grade and the cut was taken out sufficiently wide to allow for a 4.5 ft. walk on either side.

Surfacing for the balance of this section will be stamp sand and gravel.

*Section C*

Section C lies wholly through hardwood forests. It extends from station 1014 to station 1895, a distance of 16.7 miles and is all new location.

A few miles of this has been cleared and a mile or so grubbed. The soil in general is loam and quite free from rock. However, the south mile is a veritable nest of boulders. Ditches cannot be put in economically on this and money can be saved by filling 1.5 ft. or more over such places. Gravel will be used for surfacing.

*Section D*

The balance of the road, section D, extends from station 1895 to the Marquette county line, a distance of 12.4 miles. It is rather rough and there are considerable boulders the entire length of the section.

, Much of the old road through here has been given up in favor of a new location, and in so doing four grade crossings have been eliminated. To eliminate these crossings, however, took a great deal of time on preliminary surveys through a rough country, and it meant building over a granite and trap bluff and for 700 ft. across a lake.

The road extends along this rock ridge for a mile, paralleling the South Shore Railroad. As the centerline of the highway is but 83 ft. from the railroad it has been necessary for the contractor to station flagmen half a mile in either direction along the track when blasting as a "safety first" measure. Something like 5,000 cu. yds. of solid rock will be taken out in this mile.

In filling across the lake gravel from a nearby bank has been used. This runs rather coarse, containing boulders up to 1 cu. ft. or so in volume. Care has been taken in doing this work to keep the larger stone at the edge, thus building up a good rip rap. This section, too, will be surfaced with gravel.

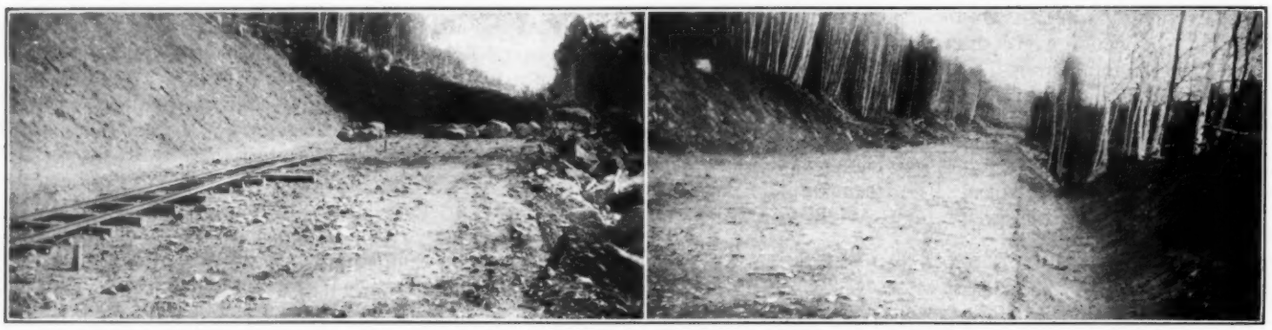
On this fedetral aid road there will be eight railroad crossings, all at grade. Besides the four crossings, eliminated as before mentioned, five yard tracks have been avoided at L'Asne by a new location. In all other cases an attempt has been made to improve the existing crossing by clearing the immediate site of all brush and trees, building up the road grade and increasing the angle of crossing where possible, at the same time being consistent with good alignment.

The grade width throughout will be 24 ft., shoulder to shoulder. A flat subgrade section is used, the ditches averaging 2 ft. in depth and 2 ft. on the bottom.

Clearing consists of close cutting all brush, trees and stumps, on a minimum width of 50 ft., measured 25 ft. each way from the centerline of the roadway. This will not only give the right-of-way a better appearance but, in many cases, will prevent snow from drifting.

At times we find it hard to enforce the clause in the contract in regard to the burning of brush, etc. The fact that it will not burn when too wet and the State Fire Wardens and others not permitting it's burning when the weather is too dry calls for some other means of disposal. However, we insist that if it is not burned it shall be so placed that it will not be an eyesore to travelers.

The contractors began work about May 1, 1918, and during the following seven months 29½ miles of grading were completed. There is also considerable work in an unfinished state.



VIEWS ON CONSTRUCTION OF BARAGA ROAD, BARAGA COUNTY, MICHIGAN, FEDERAL AID PROJECT NO. 3.

To give some idea of the amount of work to be done under the present project agreement, I have listed a few of the items entering into the work as follows:

Rock excavation—10,500 cu. yds.
Earth excavation—267,600 cu. yds.
Concrete in culverts—2,571 cu. yds.
Culvert pipe—3,474 lin. ft.
Guard rail—29,316 lin. ft.
Clearing (Sec. C & D)—125 acres.
Grubbing (Sec. C & D)—14,927 sq. rds.
Overhaul—534,828 yard stations.

All work is slope staked. Stakes are placed at the center and at the outer ditch slopes or at the foot of fill in case there is no ditch. This method has worked out exceedingly well.

Had it not been that the contractors were able to place a good many station men on the work I doubt whether much would have been accomplished the past season. The fact that railroad grading was almost at a standstill forced many men to seek other employment and naturally they took to highway grading.

Station men usually work two or three in a party, a few few stations or occasionally a mile of grading being sublet to them. One man will move on an average around 15 cu. yds. of dirt per 10-hour day. Their equipment generally consists of wheel-barrows, shovels, picks and a few lengths of plank on which to run the wheel-barrows, all being furnished by the con-

tractor. They try to move all dirt directly across the road, their "free haul" distance usually being 50 ft. Here is where close inspection is required lest many unsightly borrows are made with a corresponding waste of dirt in other places. However, I am convinced that for good, clean-cut work we would do well to employ more station men.

As stated, the plan is to surface practically all this road with stamp sand and gravel, 16-ft. in width. The construction will conform with our state specifications for class "A" roads.

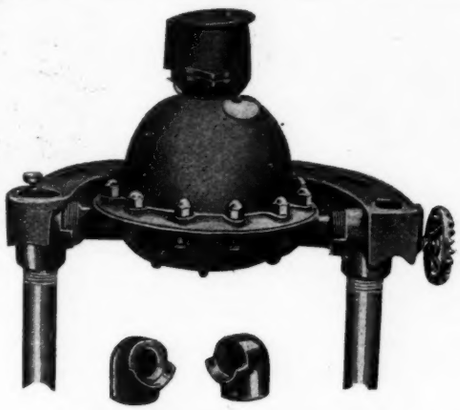
A traffic census taken during the summer of 1918 at the Houghton and Marquette county lines, namely, the north and east ends of the Baraga road, show from 75 to 200 vehicles per day. This, too, when half the road was under construction. So with the road completed it doubtless will have a traffic of double that number of vehicles.

*Acknowledgement*

The foregoing paper was presented before the recent annual convention of the Michigan Engineering Society.

## The McNutt Meter Holding Yoke

The McNutt meter holding yoke places the riser pipes on 9-in. centers, which is as close together as they can be brought and therefore farthest from the frost line. This yoke, here illustrated, is simple and convenient and can be installed by any laborer. The yoke is furnished with sole leather gaskets ready to install. With this yoke a ¾-in. meter can be set in a 15-in. sewer pipe with a 15-in. cover, and a 1-in. meter can be



McNUTT METER HOLDING YOKE

set in an 18-in. sewer pipe, using the 15 and 18-in. McNutt covers, respectively. If these installations are made according to instructions the meter will not freeze. A written guarantee against freezing is given with each setting. These meter-holding yokes are manufactured and marketed by the McNutt Meter Box Co., Brazil, Ind.

## Road Maintenance by the Patrol Method in Maine

*By Paul D. Sargent, Chief Engineer, State Highway Commission, Augusta, Maine*

During the last three years our road maintenance work has been done by the patrol method. We have entire charge of the work. We hire patrolmen and pay them direct from the Highway Department and all of their reports are made to the Highway Commission. At the end of the season, we make a report to each town showing just what work has been accomplished so they can see how their maintenance money has been expended, said Mr. Sargent in a discussion before the recent joint Highway Congress in Chicago.

*Hiring Patrolmen*

In the hiring of patrolmen we first ask the municipal officers of each town to recommend three men who in their judgment would be suitable to do the work. We had a brief statement with respect to each man as to his age, height, weight, health, nationality, and previous experience, also as to his location with respect to the road to be patrolled.

Our supervisor then went into the town, interviewed the men and hired the man who seemed to be best fitted to do the work. Frequently none of the men recommended by the municipal officers was found to be suitable and then the supervisor hunted around until he found someone.

*Reports by Patrolmen*

Instructions quite in detail are sent to the patrolmen each spring and they are visited as often as once in two weeks by one of our supervisors. They are required to make a report once a week showing what they have done each day, together with the condition of the weather. In this way the supervisor, who has charge of about 25 patrolmen, is able to keep in touch with the work. The reports after being looked over by the supervisor are sent to the Highway Commission office where the superintendent of maintenance finally reviews them and places them on file.

Patrolmen are paid once a month and the time which they send in at the end of the month has to agree with the weekly reports previously filed both as to time worked and as to classification or distribution of the labor.

*Patrolmen's Wages*

In 1916 patrolmen were paid $75 per month. For this they furnished one horse weighing not less than 1200 lbs., a drop axle wagon, and the necessary hand tools, and a drag built for one horse. During 1917 and 1918 we worked over into allowing patrolmen to use two horses, more or less. At the end of 1918 one-third to one-half of our patrolmen are hired with two horses and the men who regularly work one horse are authorized to employ an additional horse to do the dragging. During 1918 we started in paying patrolmen with one horse 44 cts. per hour and with two horses 55 cts. per hour. Due to abnormal labor conditions prevailing and to stabilize our patrol force, we made an agreement with every patrolman when we hired him this year that we should pay him only 95% of his wages each month. The remaining 5% was to be held back until the end of the season and to be paid him in a lump, provided he remained through the entire season. In case a man was discharged on account of unsatisfactory work he was not to receive this 5%. We have had very few resignations and it has been necessary to discharge but a very few men. On the first of September 1918 we increased the patrolmen's rates of pay to the following amounts: 50 cts. per hour for a man with one horse and 60 cts. per hour for a man with two horses.

*Cost of Patroling*

During the year 1916 we employed 373 patrolmen and had under patrol 3,466 miles of road. The total expenditure was $286,399 and the average expenditure per mile was $77.43.

During 1917 we employed 437 patrolmen caring for 3,705 miles of road. The total expenditure was $432,716.00 and the average expenditure per mile was $117.19.

During 1918 we have employed 480 patrolmen caring for 4,250 miles of road. I am not able to give the total expenditures but they will be about $500,000, making an average expenditure of a little over $140 per mile. These increased costs are due to the increased cost of labor and material. A little rough figuring indicates that our labor costs have averaged about 34% over 1917, which would give us roughly an average cost per mile for maintenance this year of $157.

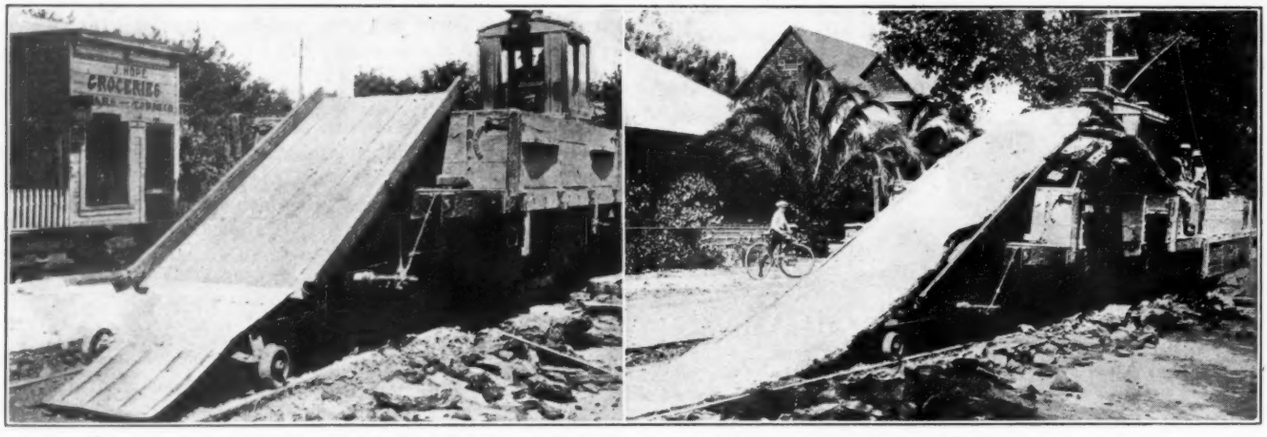
Our patrolmen show on the weekly reports the amount of time which they have spent each day on the improved road and on the unimproved road under their care. In this way we are able to control the expenditure and to keep it in about the right proportion on the different classes of road. Under our law, towns are obliged to pay toward the maintenance of state highways $60 per mile per annum provided the expenditure amounts to that, and on improved state aid roads $30 per mile per annum, the state paying the balance.

I think it is fair to state that we have approximately 100 miles of state highway which we surface treat each year, using Tarvia B and sand. The cost of preparing the road, making the surface application, and then keeping the road patched and the shoulders in shape through the season has averaged during the last three years from about $650 per mile in 1916 to $850 to $900 per mile through the present season. These figures are all included in the averages which have been given above.

## Machine for Removing and Loading Pavement as Operated by the United Railroad of San Francisco

*By L. M. Edholm, 68 Buchanan Place, The Bronx, New York, N. Y.*

The United Railroad of San Francisco has a specially constructed machine for removing the paving between their tracks. As a time and labor saver the machine more than pays for itself in a very short time. This apparatus consists of a scoop measuring 34 ins. by 63 ins. This is supported at the front end on a small iron frame on wheels. At the top end it has an eye which fits the coupling on a car. Any work car can be used. A platform 4 ft. wide and 15 ft. long extends from the car to the scoop and this has an incline of about 25 degrees,




VIEWS OF MACHINE USED TO REMOVE PAVING FROM BETWEEN RAILS.
Left: Ready to Begin Operations. Right: Machine in Operation.

The edge of the scoop is somewhat sharp with an up-turned edge and this is forced under the concrete to start the work. Then the car proceeds on its own power, the scoop shoving ahead under the layer of asphalt and concrete and raises it in a long strip which is forced up the incline and drops into the bottom of the car. When this end of the car is filled the scoop attachment is placed at the other end of the car and the same process is repeated until the car is full. Two views of the machine are shown herewith.

## How Motor Freight Transportation Aids Road Improvements

*By H. P. Branstetter, Kissel Motor Car Co., Chicago, Ill.*

A community without good roads is an isolated community, becoming more isolated as the railroads are asked to haul more and more supplies and materials for the government, as well as for the manufacturers doing government work. Communities should realize this now and "put their roads in order" before next fall and winter.

### *A Specific Example*

There is a motor truck transportation company in the South that is installing motor truck lines between cities and communities. Before each line or route is put into operation the officials of the company go to the community which they have in mind tying up with other communities and point out to local shippers the advantages and saving which motor truck transportation will enable them to make.

After they have "sold" the idea, after the shippers and merchants of this community decide they need motor truck transportation, and after they have guaranteed a necessary amount of business sufficient to warrant the motor truck transportation company operating there, the transportation company turns around and says in effect: "The roads between here and the town nearest to where our trucks are at present operating are poor roads. They are too bad for us to operate over profitably. They would make our transportation rates to you prohibitive. Before we can give you the kind of service you need, it is up to this community to make these poor roads good roads." This company is finding that in practically every instance where they make this proposition, the people of that community see to it that the roads are put in good shape, so that the transportation company can operate over them.

Truck owners know that good roads not only save money for them, but for the shipper and public as well, since good roads make possible faster time, at a saving in operating expense. This was recently proven in a test between two trucks of the same capacity, same make and same load. One truck ran between two communities on good roads and the other truck operated between two communities on poor roads. It was found that the truck operating on good roads was able to deliver its load at nearly 1/3 per cent. less cost than the other and with nearly a 50 per cent. saving in time.

This saving in time and expense not only benefits the truck owner and truck operator, but the producer and consumer, because, obviously, the cheaper goods can be shipped, the cheaper they can be sold.

## Self-Rotating Hammer Drills Used in Rock Trenching for Water Mains

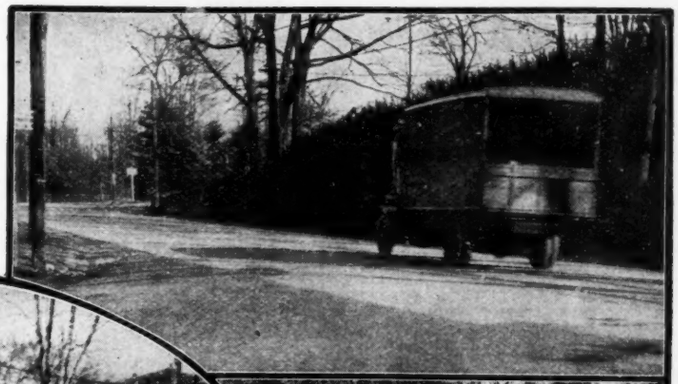
A Hummer self-rotating hammer drill was successfully employed in digging trenches into solid rock for water mains for the Hackensack Water Company, Hackensack, N. J. A Chicago Pneumatic portable gasoline-driven air compressor supplied air.

Hummer hammer drills are made in three sizes for drilling from 6 to 12 ft. in solid rock. They have independent rotation, automatic lubrication, indestructible ball valve, and are provided with exhaust throttle for clearing holes.

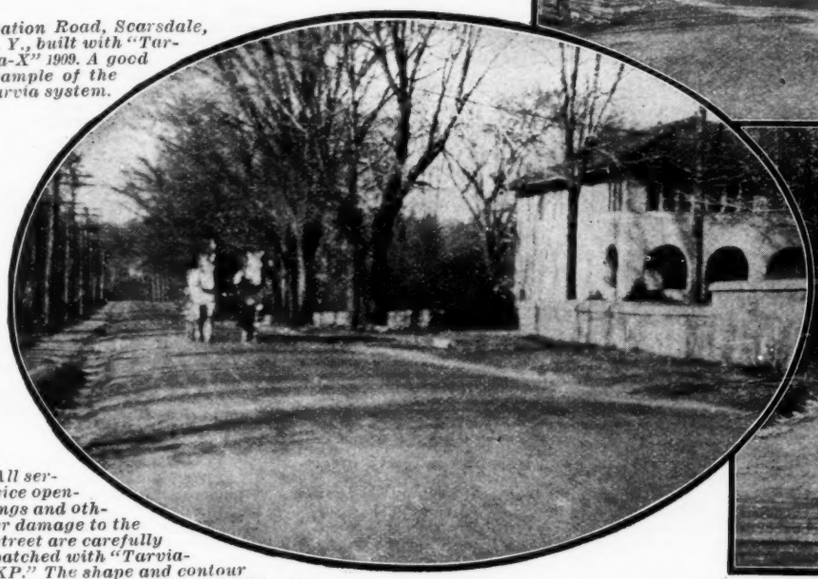
Chicago Pneumatic simplate-valve gasoline-driven air compressors may be mounted on a truck for portable work. They are also furnished stationary or skid-mounted for semi-portable work. This same machine can also be furnished for operating on fuel oil and other cheap fuels.

# Tarvia

*Preserves Roads*
*Prevents Dust*



*Station Road, Scarsdale, N. Y., built with "Tarvia-X" 1909. A good example of the Tarvia system.*



*All service openings and other damage to the street are carefully patched with "Tarvia-KP." The shape and contour are as good as when first laid in 1909.*

*Upper view shows intersection constructed with "Tarvia-KP."*

*Lower View shows "Tarvia-KP" patching on road maintained with "Tarvia-B."*

## Have You Discovered "Tarvia-KP"?

Every few weeks another road authority of some city or town or village *discovers* "Tarvia-KP," (Kold Patch) the remarkable bituminous road-patching material that can be used *at any time of the year.*

Now its Scarsdale, the beautiful residential village in Westchester County, New York. On October 29th, 1918, Franklin Henshaw, Street Commissioner of Scarsdale, wrote:

> "I regret that I did not 'catch on' to the real value of 'Tarvia-KP' until this year, as I have used over 16,000 gallons of other materials for patching each year, except 1918 when I used 8,000 gallons before trying KP. While the patching material used has been good, 'Tarvia-KP' is better and far more economical, as with 5,000 gallons of 'Tarvia-KP' I have put in very nearly as much patching as I did with 8,000 gallons of other material. Now, next time you run up against a fellow who thinks he has the best there is, make him take a barrel of KP and show him how to use it. You will have a new customer as KP works easier—goes further and makes as good a patch as anything I have ever used. Result—much cheaper and quicker patching from saving in labor."

The time is approaching when the damage caused by the inroads of winter on macadam and bituminous highways and streets must be repaired.

NOW is the time to "catch on to the real value of 'Tarvia-KP'."

Small holes filled promptly with "Tarvia-KP" patches will save many dollars of expensive repair work later on.

"Tarvia-KP" can be ordered NOW. Freezing won't hurt it; it can be used even in the winter, whenever the roads are free from snow.

Write our nearest office for free booklet showing each step in patching a road with "Tarvia-KP."

*Write for illustrated booklet and further information.*

New York Chicago Philadelphia
Cleveland Cincinnati Pittsburgh
Kansas City Minneapolis Nashville
Atlanta Duluth Milwaukee Dallas Bangor Washington Johnstown Lebanon Youngstown Toledo
Columbus Richmond Latrobe Bethlehem Elizabeth Buffalo New Orleans Baltimore

The Barrett Company

Boston St. Louis
Detroit Birmingham
Salt Lake City Seattle Peoria

THE BARRETT COMPANY, Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax N. S. Sydney, N. S.

# Contracts Awarded

ROADS AND STREETS.

**Ariz., Holbrook**—John Turley, St. Joseph, Ariz., awarded contr. for improving 3½ miles Snowflake road, at $5,702.

**Ariz., Mesa**—Southwestern Contg. Co., 13th Ave. & Lincoln St., Phoenix, awarded contract for bldg. McDonald street. Work involves 12,333 sq. ft. 4-in. conc. pavement with bithu. surface, at $2.84 per sq. yd.

**Ariz., Tucson**—Following roads to be constructed by force acct., under supervision of Wm. C. Goetz, former county engineer Pima county; Mount Lemmon road, est. cost, $25,000; Ajo to Gunsight Mountain road, $40,000; Tucson to Pinal road, $40,000; Benson to Vail road, $20,000. $125,000 bonds voted and sold.

**Ark., Duvall Bluff**—R. Mobley, No. Little Rock, awarded contract to construct road from Des Arc toward Cotton Plant, at $76,000.

**Ark., Little Rock**—Plumer & Adams, Grady, awarded contr. by State Hwy. Dept., for bldg. 18 miles gravel road, Howard Co., and 340 lin. ft. steel bridges, conc. culverts, etc., at $146,560.

**Ark., Little Rock**—Plumer & Adams, Springfield, Mo., awarded contract for preliminary work in Road Dist. No. 1. Yell County at $95,000.

**Ark., Nashville**—Healy Construction Co., Meridian, Miss., awarded contr. for construction of gravel road, steel bridges, conc. culverts, at $146,560.

**Cal., Fresno**—Thompson Bros., awarded contr. for improving San Pablo avenue—Thomas to Englewood avenues at 2.5c per sq. ft. for grading, 3.5c per sq. ft. for grading, 3.5c per sq. ft. for oiling, 60c per lin. ft. cement curbs, 14.5c sq. ft. cem. walks, $2.95 per lin. ft. for 24-in. corrugated iron culverts, $2.65 for 18-in. and $2.25 for 12-in. culverts.

**Cal., Glendale**—Geo. R. Curtis, 2440 E. 26th street, Los Angeles, awarded contract for paving East Broadway—Glendale Ave., to Vergudo Rd.—at $43,794.

**Cal., Los Angeles**—M. S. Cummings, 1302 W. 22nd street, City, awarded contract to improve Sherman Drive, at $27,777.

**Cal., Los Angeles**—Will F. Peck, 4568 Finley Ave., awarded contract for construction of cement curbs, gutters and walks in tract west of Main St. betw. 99th and 108th streets, at approx. $20,000.

**Cal., Riverside**—Johnson-Shea Co., P. O. Box 906, Riverside, awarded contr. for constructing abt. one mi. paving on Indio-Coachella road, connecting with state hwy., at $11,900.

**Cal., San Francisco**—Clark & Henry, awarded contract for paving and sewering Holly Park Circle betw. Richland avenue and Park streets at $27,793.

**Cal., San Jose**—Jno. R. Doyle, San Jose, contr. for constructing conc. pavement on Center road, at $29,867.

**Cal., San Jose**—Jno. R. Doyle, San Jose, submitted lowest bid for paving 5.2 miles Almaden road and constructing bridge over Guadalupe Crk., at $68,449.

**Cal, Santa Barbara**—Johnson & Mikesell, awarded contract for grading & constructing 5-in. conc. pavement and 454 lin. ft. Quarantina St., 30 ft. wide, betw. Victoria and Sola Sts., at $4,630.

**Fla., Jacksonville**—Dawkins Construction Co., Jacksonville, awarded contr. to pave around Florida State College for Women, at $13,800.

**Fla., Kissimmee**—Osceola County (L. R. Farmer, Rd. Supt.) will construct 3 miles brick road by county force; $40,000 available.

**Fla., Lakeland**—McDonald Constr. Company's contract with City has been rescinded and re-awarded to Alabama Paving Co., Birmingham, Ala. Work calls for 4-mile asph. paving. $80,000 available.

**Idaho, Boise**—J. J. Carroll & Salmon, Burley, Ida., awarded contract for constructing 4 miles of Idaho-Pacific Hwy. out of town of Albion.

**Ill., Benton**—Hoeffkin Bros., Belleville, Ill., awarded contract for constructing impvt. known as Pavg. Dist No. 6 at 55,835.

**Ill., Gillespie**—Sells & Koller, Pana, Ill., awarded contract for improving Macoupin Street, with brk. pavement, cement curb and gutter, including 900 ft. sewer, involving 10,470 sq. yds. brick pavement & 7,265 ft. curb and gutter, at $39,616.

**Ill., Moline**—McCarthy Improvement Co., Davenport, Iowa, awarded contract for paving 25th street, at abt. $40,000.

**Ind., Auburn**—Jas. M. Snyder, Frankfort, awarded contracts for constructing the J. E. Miller road to run east of Auburn for 2½ miles, at $47,840, and J. C. Thomas road, 2,500 ft. in Union Twp., at $12,985.

**Ind., Covington** — Following contracts awarded for gravel roads: Wm. E. Allen, Hillsboro, Ind., Bever Road, at $13,600; W. A. Thomison, Williamsport, Ind., Cox Road, at $190; Haner & Waymire, Independence, for Cater Road, at $9,724.

**Ind., Decatur**—L. O. Bears, awarded contracts by County Commissioners for constr. of Brodbeck road at $10,848 and Goldner road, at $5,834; J. G. Crum, awarded contract for Thieme road at $11,621.

**Ind., Decatur**—Smith Mathys, Berne, Ind., awarded contr. for constr. of macadam road, Wabash Twp., Adams County, at $6,375.

**Ind., Goshen**—E. A. Gast, Warsaw, awarded contract for the Whetstone, Kesler and Vandermark roads; McClintick, Colwell & Gordy, Syracuse, awarded contract for the L. A. Miller road near Syracuse, at $59,985, $10,350, $12,995 and $9,685, respectively.

**Kans., Hutchinson**—M. M. Booker, 5th Street, W. Hutchinson, awarded contr. for graveling, sanding and spreading 3½ miles of formerly clayed road on Plum St.

**Ind., Indianapolis**—Geo. W. McCray, awarded contr. for constructing gravel rd., Washington, Pike and Wayne Twps., Marion Co., 2 miles long, including constr. of bridge, at $49,450.

**Ind., Delphi**—Ross Barber, Young America, Ind., awarded contr. for constr. of gravel road, Democrat Twp., Carroll Co., at $7,177.

**Ind., Delphi**—Chas. Davis, Flora, Indiana, awarded contract for constructing a gravel and macaadm rd. in Rock Creek Twp. at $9,571.

**Ind., Paoli**—Jas. P. Wilson, Paoli, Ind., awarded contr. for constr. of 5,610 ft. road, Paoli Twp., Orange County, at $3,440.

**Ind., Paoli**—Geo. Albertson, Orleans, Ind., awarded contract for constructing 6,876 ft. of road in Northeast and Orleans Twp., including cleaning right-of-way, grading, rolling, crushed stone, constructing one 10-ft. and one 40-ft. bridge, at $8,915.

**Ind., Terre Haute**—Lane Bros., Rockville, awarded contract for 1.1 miles of road, Vigo County, at $37,500.

**Kans., Topeka**—Cook & O'Brien Constr. Co., Kansas City, Mo., awarded contr. by Shawnee Co., for paving, grading & bldg. culverts on 3,889 mi. Sect. A Federal Aid Proj. No. 4. Topeka-Lawrence Rd. on Fort to Fort Hwy., at $137,294; J. O. Patterson & Co., Kansas City, Mo., awarded contract for 55,966 mi. Sect. B., at $230,931.

**Kans., Wichita**—Globe Construction Co., awarded contract for paving with 3-in. brick on 18th St.,—Waco to Arkansas Ave; alley north of First St. Topeka to Lawrence avenue at $3.60 yd.; and alley so. of First st.,— Rhode Island to Mead avenues, at at $4.25 a yd.; Richie Brothers, awarded contr. for Waco Ave.,—15th to 18th streets, including street car right-of-way, Franklin to Murdock Ave. (asph.) at $3.57 per yd. Total of contracts abt. $40,000.

**Kans., Wichita**—Smith-Graham Co., Augusta, Kans., awarded contract for conc. road, and 41 brdg. and culverts, at $208,583.

**La., Marksville**—A. M. Wilkes, Alexandria, La., awarded contract to grade and surface 5 miles of road betw. Bunkie and Melville, at $35,644.

**La., New Orleans**—A. M. Wilkes, Alexandria, awarded contract for bldg. 5 mil. Jefferson Hwy., in Avoyelles Parish, at abt. $35,644.

**Aitkin, Minn**—Stevens Bros., St. Paul, Minn., awarded contr. for 6,780 yds. of gravel surfacing on the S. B. H. No. 10, at $15,000.

**Miss., Clarksdale**—McTige-Hughy Co., Memphis, Tenn., awarded contract for constructing 38 miles of gravel road in Coahoma Co., at approx. $5,000 per mile.

**Mo., Kansas City**—C. G. Brosnahan, 5122 Grand Ave., Kansas City, awarded contract to construct 2,043 sq. yds. bitum. macadam pavement, at $169,560.

**Nev., Carson City**—Niedt & Gavin,


YOU CAN'T DO GOOD WORK WITH POOR SAND

You can find out the grade ot your sand quickly and cheaply by testing it with a

**Universal Sand Tester**

This simple and compact device will enable you to know *good* sand or *poor* sand *at once,* and give you a permanent record of the test.

It can be used in the laboratories, at the sand bank or on the job.

It costs but $40.00.

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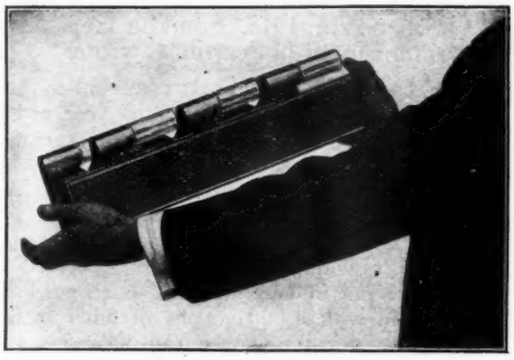

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138 Fulton Street

NEW YORK CITY

Reno, awarded contract by State Hwy. Comn., for bldg. 4.16 mi. road betw. Bulkhead and Hudson-Aurora Rd., Route 3, at about $24,815.

**N. J., Secaucus**—Clinton Contracting Co., 306 Charles Street, West Hoboken, awarded contract by Comrs. Hudson Co., Jersey City, for grading and improving County Avenue, Paterson Plank Rd. to County Ave., at cost plus percentage.

**N. Y., Northport**—C. D. Schlemmer, Islip, awarded contract by Village for 18,400 sq. yds. cement conc. pavement, at $45,448.

**N. C., Asheville**—Asheville Constr. Co., Asheville, awarded contract by Buncombe Co., to grade section of Henderson Road—Arden to county line; 8,700 sq. yds. gravel-ing; $8,000.

**N. C., Wilmington**—J. L. McGehee Contracting Co., awarded contract for furnishing material for base and laying brick using its own working force & machinery, at $2.25 per sq. yd. and $2.05 for laying conc. base.

**N. C., Wilmington**—Austen & Bennett, 836 Equitable Bldg., Baltimore, Md., awarded contract to construct 9,000 sq. yds. street; brk. on 5-in. conc. base, at $40,000.

**N. C., Winston-Salem**—C. M. Thomas & Co., local, awarded contract to pave Burke street—W. 4th to intersection of Shallow-ford and W. 4th streets—abt. 1,700 ft., at $14,774.

**Ohio, Columbus**—Following road contracts awarded by State Highway Dept.; Sects. N. S. & P., Cleveland-Buffalo rd., Ashtabula County, to F. P. Fitzgerald. Ashtabula, at $421,418; Sect. G., Savannah-Vermillion road, Ashland Co., to Walter S. Newhall Co., Cleveland, at $104,752; (monolithic brick) & $67,974 (plain brk.); Sect. O., Cleveland-E. Liverpool road, Columbiana Co.; Hardin & Mauer, Sidney, $20,334; Sect. T., Steubenville-Cambridge rd., Guernsey county, J. P. Mumaw, Huntington, W. Va., $21,697; Sect. A., McConnellsville-Spencer rd., Guernsey Co., Oliver G. Shafer, Caldwell, $22,150; Sect. I., Milford-Hillsboro rd., Highland Co., Brewer & Brewer, Chillicothe, waterbound macad., $43,276; Theodore Vogelsang, London, Bitum. macad., $49,000; Sect. K., Milford-Hillsboro rd., Highland Co., J. M.; Snouffer, Columbus, bitum. macad., $89,147; waterbound macad., $84,964.

**O., Mt. Vernon**—County Commrs., have recommended that Edwards & Irvine be given contract for paving 2 miles of Columbus road south of So. Vernon pavement, at $58,200.

**O., Youngstown**—Jas. Colucci, awarded contract for constructing sewer in Pine Hollow Drive, at $2,470.

**O., Youngstown**—Weimer-Harris Constr. Co., City, awarded contract for improving Belle Vita Ave., Mahoning Ave., to Salt Springs St.; Davis Lane-Federal to Dearborn St., by grading and others, at $6,950.

**O., Youngstown**—Olson Construction Co., awarded contract for paving South Ave., from old city limits to Indianola Ave., at $44,194; Kelley & Meyer, for paving Florida Ave.,—Erie to South, at $24,205, and Rush Blvd., Indianola to Florida, at $11,547; Jas. Alcorn, for paving portion Warren Ave., at $27,947; Jas. Colucci for sewer work in Pine Hollow Drive at $2,470; P. Grady, for grading Oakland Ave.,—Jefferson to Worthington, at $1,844.

**Okla., Chickasha**—W. R. Palmer, Frederick, awarded contr. to construct 11 miles of road from 3 miles south of here to Minco, at $14,000.

**Okla., Duncan**—Frank Waldridge, Duncan, awarded contract by Stephens Co., Commissioners to construct 3 miles of road betw. Marlow and northern part of county, at $6,875.

**Okla., El Reno**—T. C. Ottinger, Anadarko, Okla., awarded contract by Canadian County Commrs., to surface 4 miles Meridian Hwy., leading north from El Reno.

**Okla., Miami**—F. P. McCormick, Tulsa; awarded contract to pave 2nd, 3rd, Main and H streets, with asph. concrete, at $61,790.

**Okla., Miami**—Western Paving Co., awarded contract to construct 17 miles of concrete road, at $321,440.

**Okla., Okla. City**—Western Paving Co., 518 Terminal Bldg., City, awarded contract for grading, draining, curbing and paving Park Place—Blackwelde to Kentucky Sts., and McKinley Ave., Linwood to 10th streets and 11th Sts., at $71,460.

**Okla., Okla. City**—Western Paving Co., 518-19 Terminal Bldg., awarded contract to pave 12th street—Broadway to Oklahoma Ave., Olie Ave.,—17th to 18th Sts.; 13th St., Western Ave. to right-of-way of Okla. Ry. —part of block on Classen Blvd. and 10th St., west of Hudson Ave., at $16,903.

**Ore., Roseburg**—H. J. Hildeburn, local, awarded contract for grading Pacific Hwy., Douglas County. Work requires 47,500 cu. yds. excav., for grading of strip 5.1 miles long.

**S. D., Deadwood**—Hanson Bros., City, awarded contr. for retaining walls, culverts and conc. work on percentage basis.

**S. D., Deadwood**—Wm. H. Butler, Sturgis, S. D., awarded contr. for constructing 1.75 miles of road, involving 4,000 cu. yds. solid rock excav., at $1.25 per cu. yd., 7,000 cu. yds. loose rock excav., at 85c per cu-yd., and 4,000 cu. yds. excav., at 50c per cu. yd.

**Tex., Cisco**—Municipal Paving Co., Dallas awarded contract to construct 40,000 sq. yds. streets, at $54,000.

**Tex., El Paso**—Commrs. have agreed to sign contract with El Paso Bithulithic Co., for impvt. of Alamogordo-Newman road, at about $30,000.

**Tex., Galveston**—W. A. Kelso, Galveston, awarded contract to resurface Dickinson-League City Rd.,—8,600 cu. yds. with mud shell 6-ins. thick at $18,019.

**Tex., Gonzales**—W. T. Montgomery, awarded contr. for grading, graveling approx. 24 miles of hwy. No. 3, known as Houston-San Antonio Hwy., betw. Belmont and Waelder; Walsh & Bourney, San Antonio, awarded contr. for cement constr. on same hwy—total cost of constr. $210,000.

**Tex., Houston**—Texas Bithulithic Co., awarded contract to pave Washington Avenue—Wichmann street to the city limits at Reinerman street—23 blks., at $60,824.

**Tex., McAllen**—Finley Method Co., Houston, awarded contract to construct streets of gravel base, trap rock and tarvia, at $75,000.

**Tex., Van Horn**—W. E. Hamilton, Monahans, awarded contr. for grading, graveling and bridging 43 miles of road on state hwy. No. 1, at $68,000.

**Tex., Victoria**—Uvalde Rock Asphalt Co., awarded contract to pave 19 blks. of city streets, including East Santa Rosa, Moody, Forrest and Vine Sts., Goodwin and Stayton Aves., at $36,513.

**Utah, Ogden**—Strange & Maguire, Salt Lake City, awarded contract for bldg. Hooper post road, (abt. 9¾ miles) at $65,-000.

**Va., Manassas**—Wm. P. McDonald Construction Co., East Lincoln Avenue, Vernon, N. Y., awarded contract for grading and constructing roads in Prince William County at approx. $155,000.

**Va., Petersburg**—Perkinson & Finn, awarded contract by United Camp Corp., to pave Bank street—from gashouse to Camp Lee—at cost to city of $15,000; Camp Corp. to pay balance.

**Va., Staunton**—Brooks Bros., Stuart's Draft, Va., awarded contract for improving section of Rockfish and Waynesboro Greenville roads in South River District, at $7,100.

**Wash., Pasco**—California Road Oiling Co., Spokane, awarded contr. for construction of Paradise-Buehler road northeast of Connell, at $6,660; C. G. Betis, Spokane, awarded contr. for Pasco-Burbank road at $9,482.

**Wash., Seattle**—C. C. Snyder, Pacific Bank Bldg., Seattle, awarded contr. for constructing Wm. Calvert, Jr., Rd., including trestle and approaches at $4,940.

**Wash., Seattle**—C. C. Snyder & Co., Pacific Block, City, awarded contr. by King County Commrs., to construct the Boddy-Hindle Road, at $15,800.

**Wash., Seattle**—R. M. Hardy, 913 Seaboard Bldg., Seattle, awarded contract for laying 90,000 sq. yds., concrete paving on what is known as the Nachez Valley road out of Yakima, at $215,000. Road will be 18 ft. wide and 8½ miles long.

**Wis., Wausau**—Wausau Iron Works, awarded contract for erection of 23,000-gal. steel storage tank for road oil; same to be completed abt. May 1st.

### SEWERAGE AND SEWAGE TREATMENT.

**Ariz., Globe**—Clark & Henery Constr. Co., Stockton, Cal., awarded contr. for construction of sewer system, using machine made pipe; also sewage disposal plant with Imhoff septic tanks, at $245,278.

**Ark., Morrilton**—S. R. Morgan & Co., Little Rock, awarded contract to construct sewer system, at $16,003. 15,900 lin. ft. vitr.


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pipe, 51 manholes, reinf. conc. septic tank, etc.

**Cal., Manteca**—P. Montague, awarded contract for bldg. trunk line sewerage system, involving $15,700 ft. 10-14 in. sewer pipe at abt. $21,405.

**Cal., Sanger**—Frederickson & Shannon, Fresno, awarded contr. for constr. of an extension to sewer system, and erect. of cottage at sewer farm, at $11,000.

**Fla., Key West**—Florida Constr. & Engineering Co., Key West, awarded contract to extend sewer and water systems at navy yards, at $45,000.

**Fla., St. Petersburg**—Southern Construction Co., St. Petersburg, award. contract to construct 14,750 ft. sewer and 2 septic tanks, at $21,395.

**Ga., Thomson**—J. B. McCrary Co., Atlanta, Ga., awarded contract to construct sewer system, at $21,000.

**Ind., Muncie**—Cornelius Delaney, award. contract for Liberty street sewer, No. 4 at $1,033; Wm. Birch Co., awarded contract for Sixth & Liberty street sewer, at $1,920.

**Ky., Dalton Springs**—Railroad Water & Coal Handling Co., Chicago, awarded contr. by Illinois Central R. R., Chicago, to construct pump house; 2 25-H. P. oil burning engines; 100,000-gal. tank and 10-in. discharge line.

**N. Y., Long Island City**—Green Construction Co., 734 Verona Avenue, Flushing, awarded contract for bldg. sewers in Hobson Ave., Jones Ave., Laurel Hill Blvd., Montgomery Ave., and others, at $181,896.

**N. Y., Long Isl. City**—H. J. Mullen, Contracting Co., Inc., Fulton St., Brooklyn, awarded contract by Queens Boro. for bldg. sewers in 80th St., Atlantic Ave., 76th St., 93rd Ave., Elderts Lane, 78th St., and others, at $209,068.

**N. Y., Schenectady**—Ellis B. Edgar, awarded contract for constr. of 24-in. storm sewer in old Erie canal—College creek to west side of Nott St., at $4,517.

**N. Y., Syracuse**—J. Young, 509 Bastable Blk., awarded contr. by City for bldg. Sec. A of 17th Ward sewer on Lombard street—Maple street to point east, at about $36,-985.

**N. Y., Syracuse** — Samuel Palmukco, awarded contr. for bldg. sewer in Harrison Pl., at about $36,985.

**N. D., Forman**—Great Northern Bridge Co., Wahpeton, awarded contract by Sargent County for laying drains, at abt. $15,-000.

**Ohio, Cleveland**—River Construction Co., awarded contract to construct sewer in W. 74th street—80 ft. so. of Wakefield Ave., to 470 ft. northerly, at approx. $4,000; Zegiob & Joseph, awarded contr. for constr. of sewer in Carnegie Ave., SE., (extension) from E. 89th St., to E. 100th street, to E. 110th street, at $6,400.

**O., Sandusky**—M. J. Callaghan, Sandusky, awarded contr. for bldg. sewer & 12 in. water line in Sycamore Ave.; also Lane & Wayne streets, at about $20,022.

**W. Va., Charleston**—Wilcher & Lane, 738 Crescent Road, awarded contract to construct sewer at Swanns Hill; 459 ft. 8 to 15 in. terra cotta pipe.

**Wis., Eau Claire**—Nels Johnson, Marshfield, awarded contract for constr. of sewer, at $9,000.

## WATER SUPPLY AND PURIFICATION.

**Cal., Arcadia**—J. L. Ackland, 818 So. Kingsley Drive, Los Angeles, awarded contract for constructing reinf. conc. reservoir with roof for the Walnut Grove Mutual Water Co., at $9,500.

**Fla., Key West**—Florida Constr. & Engrg. Co., Key West, awarded contr. to extend water and sewer systems at navy yards, at $45,000.

**Fla., Key West**—So. Florida Contracting & Engrg. Co., awarded contr., by Navy Dept., to construct 40-ft. rein. conc. tower, 750,000-gal. tanks, etc., at $80,000. Use 6,000 ft. wood pipe.

**Ga., Thomson**—J. B. McCrary Co., Atlanta, Ga., awarded contract by Thomson Light & Water Co., to construct water works.

**La., Baton Rouge**—Graver Tank Works, 4809 Todd Ave., Chicago, awarded contract by Ill. Central R. R., Central Sta., Chicago, for bldg. 1sty. 25x40 ft. filter plant here with 25,000-gal. capy. per hour, at abt. $18,-000.

**Md., Baltimore**—American Water Softener Co., Philadelphia, Pa., awarded contract to furnishing 32 filter operating tables for Montebello filters at $23,500.

**Mich., Grand Rapids**—VerHey & Kloet, awarded contracts for work in Cordelia, Wealthy and Atlantic streets; Harry Hoxie, contract for laying mains in LaGrande street and Penn. avenue.

**Mich., Saginaw**—Allis-Chalmers Mfg. Co., West Allis, Wis., awarded contr. for water works addition in the old west side water works.

**Minn., Bemidji**—Layne & Bowler, Memphis, Tenn., awarded contract for installing pumping system; also 2 reservoirs, at $35,-000. Reservoirs—200,000 gal. capy.

**Minn., Foley**—McCarthy Well Co., Wabash & Eustis Sts., Minneapolis, award. contract for well.

**Minn., Greenbush**—Mike Shimpa, award. contr. for well; 8-in. casing, 200 ft. deep.

**Minn., Hallock**—Des Moines Bridge & Iron Co., Des Moines, awarded contr. for steel water tank, capy. 60,000 gals., at $6,500.

**Mo., Kansas City**—E. H. Bradbury, awarded contr. by City Fire & Water Bd., for excavation for 2 reservoirs at Wabash and St. John Avenue, at $51,200; conc. basis, cost $ 30,000; storage capy., each 8,000,000 gals.

**Neb., Geneva**—F. B. Bentley, awarded contr. for city well at $6,750.

**Neb., Lincoln**—Western Supply Co., Lincoln, Neb., awarded contract for 300 ft. 12-in. standard black steel pipe for water works system, at $2.97 per ft.

**N. Y., Cohoes**—Alpha Electric Constr. Co., 102 Hamilton St., Albany, award. contract to build addn. to pumping plant, at about $8,000.

**N. C., Asheville**—City Commrs. accepted proposition of W. R. Campbell, to install pipe line, pump and reservoir for E. W. Grove.

**N. C., Winston-Salem**—C. A. Heilig & H. H. Sherill, local; also Mr. Lane, Lane Brothers, Charlottesville, Va., awarded contracts to construct conc. dam for reservoir, at $102,000. Will store 750,000 gals. of water.

**O., Cincinnati**—Babcock & Wilcox Co., Boston, awarded contract for installation of 2 additional high-power boilers at Calif. Pumping Station of Cincinnati Water Wks., at $48,000.

**Pa., South Bethlehem**—Roydhouse-Arey Co., Fidelity Bldg., awarded contr. for water supply system, at abt. $50,000.

**Pa., Philadelphia**—W. H. McCloskey, Jr., 1620 Thompson St., Philadelphia, awarded contr. for water tower, pump and tank house on Gray's Ferry rd., at $15,567.

**Pa., Philadelphia**—Harry F. Lodge, 1632 Ranstead St., awarded contr. for water supply and drainage system, at $28,000, Grays Ferry Rd.

**Tenn., Kingsport**—Pittsburgh Filter Mfg. Co., Pittsburgh, Pa., awarded contract to erect filtration plant abt. 7 miles from here, at $50,000.

**Va., Norfolk**—General Contracting Co., Norfolk, awarded contract to erect six 750,-000-gal. filter tanks at water works pumping station.

**Wis., Janesville**—J. P. Sullen Constr. Co., Janesville, Wis., awarded contract for water mains, 18-in. across Rock River, 465 ft.

## BRIDGES AND BUILDINGS.

**Ark., Fort Smith**—M. M. Elkan, Macon, Ga., awarded contr. for constr. of concrete free bridge over Arkansas River at foot of Garrison avenue, at $538,000. Bridge will be 3,188 ft. long, connecting Ark. & Okla. Work will start immediately and be com-


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**Fla., Chattahoochee**—Masters & Mullen, Cleveland, Ohio, awarded contr. by State Rd. Dept., to construct bridge across Appalachicola River at Chattahoochee and to Converse Bridge & Steel Co., Chattanooga, Tenn., for steel lift; 1,034 ft. long, 7 conc. arches 110-ft. clear span and basc. lift with 100-ft. clear channel opening, 18-ft. rdway. Est. cost $187,000.

**Idaho, Cataldo**—Security Bridge Co., 502 N. 32nd St., Billings, award. contract for bldg. bridge, at abt. $29,875.

**Ill., Aurora**—C. B. & Q. Railroad, 547 W. Jackson Blvd., Chicago, will construct viaduct on High street by day labor. Abt. $3,000,000. A. W. Newton, Chicago, Ch. Engr.

**Ill., Rockford** — Milburn Bros., City, awarded contract for bldg. conc. culvert on Charles St., in Rockford Twp., at $1,050; Ray Mann, Rockford, awarded contract for bldg. Smith bridge, reinf. conc., at $2,040, and conc. bridges in Cherry Valley Twp., at $3,796.

**Ill., West Union**—Jno. Bash, Darwin, Ill., awarded contr. for constructing 2 reinf. conc. abutments and moving and erecting old steel superstructures in York Twp., Piety brdg., etc., at $5,895.

**Ia., Dubuque**—Barnd Bros., Manchester, awarded contract to build bridge near Rockdale at $1,842.

**Ia., Eddyville**—Whitlatch Bros., Beacon, awarded contract for bldg. brdg. in Mahaska county during year 1919.

**Ia., Oskaloosa**—Whitlatch Bros., awarded contract for bldg. all bridges in Mahaska county for year 1919. R. W. Varney, Aud.

**Ind., New Castle**—Burk Constr. Co., awarded contract by Henry Co. Commrs. for several culverts and bridge repairs, at $3,096.

**Kan., St. John**—Alec Helwig, Great Bend, Kans., awarded contr. for constr. of Meggers bridge at $1,624 and Siferg brdg. at $955; Prose & Grisier, Macksville, Kans., for bldg. Speed bridge, at $3,280; Ray Vincet, St. John, Kans., for constructing Newell bridge, at $900, St. Thomas bridge, a $925 and Duley brdg., at $800.

**Kans., Topeka** — **Fred. Luttjohann**, Topeka, awarded contr. for constructing 4 bridges over Deer, Stinson, Tecumseh & Whitson creeks on new Fort to Fort hwy., betw. Ft. Riley and Ft. Leavenworth, at $42,011.

**Kans., Topeka** — Following contracts awarded for constr. of conc. brdg. wk. in Topeka & Tecumseh Twp., Shawnee Co.: Cook & O'Brien, Kans. City, Sec. A, at No. 137,293; J. O. Patterson, Kans. City, Sec. B, at $250,930; Wichita, Kans. Missouri Valley Bridge Co., awarded contr. for constructing bridges on proposed paved rd. to be built on Central Ave. from city to 7 miles east of county line, at $17,201; Smith-Gramah Constr., Co., Augusta, Kans., awarded contr. for constructing 41 bridges and culverts, & concrete road, at $208,503.

**Ky., Louisville**—Capitol Constr. Co., Columbus, Ohio, awarded contr. to construct wood block floor on bridge over Salt River, at $30,800.

**Mass, Braintree**—Boston Bridge Co., E. Cambridge, awarded contract for bldg. Scherzer double leaf draw for hwy. over Monaticquot Crk., at abt. $53,000.

**Mich., Lowell**—J. C. Hatch & A. Lewis, Lowell, awarded contract for trunk line bridge No. 210, 1½ miles n. e. of here, crossing Flat River; 2 reinf. conc. bridges with reinf. abutms., 1 plain conc. pier, etc., at $11,059.

**Minn., Grand Rapids** — Jno. Lofberg, Grand Rapids, awarded contr. by Itasca Co., for reinf. conc. arch bridge, 50-ft. span, 18-ft. rdway, at $5,700.

**Minn., Thief River Falls**—Minneapolis Bridge Co., awarded contract for constr. of steel bridge over Red Lake river in town of Kratka, at $7,875.

**Miss., Macon** — L. C. Cline, Macon, awarded contr. by Noxubee Co., to constr. 4 brick arches on Binion & Skinner road, 16 mi. from here and 2 brk arches over Ash Creek on Macon & Cooksville road at $2,543.

**Mont., Bozeman**—Clifton Applegate-Toole Co., 2 N. Cedar St., Anaconda, awarded contr. for bldg. Red Bridge; also Axtell Brdg., at $15,724.

**Nev., Fallou**—Parrott & Thompson, Salt Lake, contract for constructing an 87-ft. brdg. over Truckee Carson Canal near here, involving 175 cu. yds. excav., 504 lin. ft. conc. piles, etc., etc., at $7,449.20.

**Okla., El Reno**—G. M. Stone, awarded contr. by Canadian County Commrs., to construct 7 bridges, at $12,580.

**Okla., Mangum**—W. B. Henry, Mangum, awarded contr. by Greer County Commrs., to construct bridge, culvert and earthwork embraced in State-aid projects Nos. 2, 3, 5, and 7.

**Okla., Tulsa**—Roach & McNulty, Tulsa, awarded contr. to construct culvert at $8,828.

**Pa., New Castle**—F. S. Wilson, Kittanning, awarded contract for bldg. 1 thru span steel brdg., 218 ft. long, over Neshannock Crk. on So. Mill St., at abt. $113,800.

**Pa., Tionesta**—Whittaker & Diehl, Union Trust Bldg., Harrisburg, award. contract by State Comn., for bldg. conc. bridge across Tionesta Crk., at abt. $64,965.

**S. D., Deadwood**—Hanson Bros., awarded contract for retaining walls, culverts, etc., during year, by Co. Commrs. Lawrence County.

**Va., Roanoke**—R. A. Figgatt, 312 Terry Bldg., Roanoke, awarded contracts as follows: concrete bridge costing $3,000 for Alleghany County; three 25-ft. span conc. brdg., Bedford County, at $6,000 and 3 conc. brdgs., Botetourt Co., at $3,000 each.

**Wash., Tacoma**—C. F. Bergstrom & Son, awarded contract to rebuild Fife-Milton bridge at $1,560; D. W. Rutherford, McMillin bridge, at $9,875 and P. C. Walesby, Marshall avenue structure at $940.

**Wis., Oshkosh**—Scherzer Rolling Lift Bridge Co., 53 W. Jackson Blvd., Chicago, awarded contract for bascule bridge over Fox River, at $200,000.

## DRAINAGE AND IRRIGATION.

**Cal., Arcadia**—J. L. Ackland, 818 So. Kingsley Drive, Los Angeles, awarded contr. at approx. $9,500 for constr. of reinf. conc. reservoir with roof, but without pipe and fittings, at Arcadia for Walnut Grove Mutual Water Co.; Lacy Mfg. Co., Los Angeles, awarded contr. for pipe and fittings, at $2,600.

**Cal., Anaheim** — Ben Baxter, awarded contract for installing 1000 ft. 10-in. cement pipe for B. G. Rodger, North street; also 1,000 ft. 6-in. cement pipe for David Fairbarin, Olive; constructing 8-in. & 10-in. cement irrig. pipe lines on J. C. Travis' ranch of several hundred acres at Esperanzo in Santa Ana canyon.

**Cal., Blythe**—J. G. Donovan, 780 Lyon St., Los Angeles, awarded contr. at 55c cu. yd. for constr. of a cut-off canal across Palo Verde bend. Canal will be approx. 2½ mi. long; Palo Verde Mutual Water Co., contr. for construct'g, abt. 4 mi. levee, involv'g. 185,000 cu. yds. earth wk., at 20c cu. yd.; P. B. Eogh, contr. for constr. of abt. 4 mi. levee, involvg. 180,000 cu. yds., at 20c cu. yd.

**Cal., El Centro**—Wm. Ledbetter Co., Pacific Electric Bldg., Los Angeles, awarded contr. for constr. of reinf. conc. headgate structure at Sharp's Heading, Alamo canal, abt. 9 mi. east of Calexico in Mexico, at $110,000.

**Cal., Lindsay**—W. A. Kramer, 1000 Marsh-Strong Bldg., Los Angeles, award. contr. for 1-in. cement lining in Lindsay-Strathmore Irrig. Dist's. reservoir at El Mirador. Wk. involves some excav't. & abt. 105,000 sq. ft. cement lining. Contract price, 50c cu. yds. for excav'g & 10½c sq. ft. for trimming and lining. Cement will be applied with cement gun.

**Cal., Porterville**—Concrete Pipe & Construction Co., Porterville, awarded contract for laying irrig. pipe in Edison district.

**Fla., Bradenstown**—Foster & Long, Bradentown, awarded contr. by Manatee Co. Commrs., to construct Oneco drain and laterals and $24,732, and to constr. drain in Pierce Saw Grass Drainage Dist., at $32,207.

**Ga., Royston**—Wade A. Watson, awarded contract by Beaverdam Crk. Drainage Dist. Commrs., to construct canal, 12 to 16 ft. bottom, 8 2/3 mi. long; drain 667 acres for farming, at $25,000.

**Ia., Jefferson** — Following contracts awarded by Board of Supvrs., Green County, for furnishing material and constructing drain No. 128; Material to Jefferson Cement Product Co., Jefferson, Ia., at $65,355; Labor to Wm. Condon, Jefferson, at $43,670.

**Ind., Greenfield**—Wm. L. Dillon, Detroit, Mich., awarded contr. for furnishing and laying 24,680 ft. tile in the Wm. L. Cook Drain in Hancock and Madison Twps., at $9,100.

**La., Lake Charles**—Lake Arthur Dredg. Co., Beaumont, Tex., awarded contr. for bldg. Sulphur Draing. Dist. No. 3, Calcasieu Parish, sect. 1, at $106,000.

**La., New Orleans**—Smith & Nordstrom, awarded contr. by State Bd of Engrs. to enlarge Sec. No. 1, Hymelie levee; removal of 40,000 cu. yds. earth.

**Minn., Ada**—Strom, Deggernes & Hanson, Gary, Minn., awarded general contr. for Judicial Ditch No. 56, Norman & Clay Cos., at following prices: excav., 9.83c per cu. yds., leveling $275 per lin. mile.

**Minn., Duluth**—Northwestern Drainage Co., Thief River Falls, awarded contr. by St. Louis Co., for constr. of Ditch No. 6, at total cost of $245,000.

**Minn., St. Paul**—D. W. Moore, St. Paul, awarded contr. for construct'g ditch in New Canada, at $4,998.

**Mo., Sandy Hook**—Pope Constr. Co., Jefferson City, Mo., awarded contr. by Sandy Hook Draing. Dist. to construct draing. system, at $63,000.

**S. D., Madison**—M. Cosgrove Constr. Co., Madison, S. D., awarded contr. for digging ditch & trenches & laying tile therein & backfilling trenches; also construct'g. open ditch & 1 conc. outlet wall at $2,775; National Sewer Pipe Co., contr. for furnish'g. tile & distributing tile along line of the ditch, at $2,923.

**Tex., Beaumont**—J. Jacobson, awarded contr. to construct 12,000 yds. dredging and 500-ft. quay wall.


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# PROSPECTIVE WORK

## ROADS AND STREETS

**Ark., Imboden**—$80,000 allowed for constr. of good roads in western district of Lawrence County, 36 miles of which have been surveyed.

**Ark., Pine Bluff**—Roy Roy—Bayou Meto Rd. Dist. considering constr. of 62 miles of road costing $300,000 along Big Bayou Meto to Arkansas County line. Robt. Williams, Co. Judge, Pine Bluff, Jno. F. Sennett, New Gascony, Ark., Commr.

**Ark., Walnut Ridge**—Lawrence County Commrs. have $80,000 state appropriation for constr. of 110 miles of roads, 36 miles of which have been surveyed.

**Cal., Los Angeles**—Los Angeles County having plans prepared by F. H. Joyner County Engr., for bldg. 22 miles of hwy. through Malibu ranch north of Santa Monica. Project includes heavy grading, conc. head walls, bldg. c. i. culverts, timber bridges, etc., etc.

**Cal., Merced**—Comm. of Merced Co. Bd. of Supvrs. and the County Advisory Hwy. Bd. investigating prices and sources of supply of crushed rock, sand and cement, which will be needed in large quantities for constr. of 125 miles of paved highways, provided for under $1,250,000 bond issue, which has just been sold.

**Cal., Rio Vista**—Preliminary steps under way for bldg. new state hwy. between Suisun and Rio Vista—abt. 24 miles. Plan involves expendt. of abt. $350,000. Details have been decided at joint sessions of Solano Co. Bd. of Supvrs. and representatives of State Hwy. Comn.

**Cal., San Diego**—City plans to expend $353,000 for hwy. & bridge bldg. Wk. provides for paving with conc., asph. and Warrenite 15 to 20 miles of streets within the city, and constr. of one steel bridge over San Diego river, also number of conc. culverts.

**Cal., San Francisco**—City has $130,000 available for street improvements during 1919. Street and sewer improvements being considered amounting to $1,500,000.

**Cal., San Francisco**—Specifs. for constr. of 40-ft. paved hwy. along ocean hwy. from Cliff House to Sloat blvd.,—abt. 2 miles—have been approved. Est. cost $70,000, which will be furnished by state auto funds.

**Cal., San Francisco**—Plans to raise $1,700,000 to construct hwy. from Merced to El Portal—abt. 70 miles—were inaugurated at luncheon attended by prominent business and professional men; plan includes provisional to turn new road over to state upon completion. Rudolph Spreckels, San Francisco is originator of the plan.

**Ont., Niagara Falls**—Hon. F. G. McDiarmid, minister of hwys., announces the construction work on Hamilton—St. Catharines—Niagara River hwy., will have first place on road program for western Ontario this year. Various counties also appropriating from five to six million dollars for this year's work; government's expendt. will amt. to about three million.

**Colo., Denver**—City will expend $216,000 for street and sewer inpvts.; wk. to start early in Spring. Frank M. Ladd, Ch. Bldg. Inspector.

**Conn., Hartford**—State Hwy. Comn., considering expendt. of $2,500,000 to construct hwys., bridges, etc., and $1,500,000 for maint. and replacements. Federal Govt. will appropriate toward cost. C. J. Bennett, Comr.

**Del., Wilmington**—Work will start in April on street and sewer improvements in city. Est. cost of work, $75,000; Jno. W. Lawson, Mayor.

**Ida., Lewiston**—$113,000 bonds voted for constr. of link in Lewis-Clark Hwy.,—Spalding to Clearwater county line near Peck.

**Ill., Decatur**—Work will start in April on street improvements. Est. cost $80,000. For information address Dan Dinneen. Other paving plans being considered; cost not yet estimated.

**Ill., Rockford**—$145,000 bonds sold; funds to be used for constr. of Charles street rd. to the Boone county line.
1920.

**Springfield, Ill.**—Approx. $8,000,000, in addition to the sixty million dollars to be raised by bond issue passed in November, is available for road work in this state; work to begin in spring. Ch. Hwy. Engr. Clifford Older announces that the Lincoln Hwy. Chicago to Springfield section of Dixie Hwy., and Chicago-Wisconsin Hwy. are roads designated for first improvement. $6,000,000 of the $8,000,000 now available, will be used for constr. of these roads. In addition to these funds $2,000,000 (approx.) is available for state aid work in different counties in state. General Assembly will be requested to appropriate two million dollars more to complete season's program and to meet federal aid available on July 1,

**Ia., Adair**—If Council can secure satisfactory prices on the work, 30 to 40 blocks of paving will be laid in very near future. Petition circulated has been signed by 85% of the property owners.

**Ia., Davenport**—Plans, specifs., etc. completed and on file for repaving grading and curbing following streets and allays; Fourth street, east line of Warren to east line of Iowa streets; asph., conc., brk. or bithulithic, $57,249; Iowa Streetasph. conc., brk., or bithu., $13,165; 14th St., similar materials, $46,556; Harrison St., same materials, $6,714; Kirkwood Boulevard, $27,099; 2nd St., $40,177; 3rd St., $47,662; Pershing Ave., 14,449; Hugo Moeller, City Clk.

**Ia., Des Moines**—Council has ordered approx. $1,000,000 worth of paving & curbing work, contracts for which will be awarded during the coming months and construction to start early in spring. Program calls for 240,000 sq. yds. paving.

**Ia., Emmetsburg**—Supvr. Steiner Mallard reports that arrangements are being made to gravel 60 miles of county roads during present year. Members of Bd. now locating gravel pits and taking options on same.

**Iowa, Logan**—City considering paving about 60 blocks.

**Ia., Monticello**—Plans under way to construct graded & graveled road—Colesburg to point on Hawkeye hwy. near Earlville—abt. 10½ miles. Est. cost $50,000, of which Delaware County will pay $30,000 and Twp. $20,000.

**Kan., Wichita**—City contemplates expendt. of $225,000 for street and sewer improvements, L. R. Ark, City Mgr.

**La., Amite**—Tangipahoa Parish, 3rd Ward, having plans prepared by Jas. M. Fourmy, Hammond, La., for 13-mile link in Burlington Hwy. $100,000 bonds previously authorized.

**La., Baton Rouge**—Plans for constr. of good roads costing approx. three million dollars in East Baton Rouge Parish, announced by W. E. Atkinson, Parish Engr. Plans call for 345 miles of road, of which 71 will be of conc. construction.

**La., Colfax**—Grant Parish Police Jury will build 20-mile section of Jefferson Hwy. Est. cost $245,000.

**Mass., Boston**—City will expend $200,000 for street and sewer impvts.; bids to be called during period betw. April 1st and December, 1919. Work of similar nature also contemplated to cost abt. $1,450,000; funds to be raised by tax levies or special assessments; work to start betw. April and December, 1919.

**Mass., Lynn**—Committee on Ways & Drainage recommend paving of following streetse: Lynnfield, Kyoma Square, northerly, 2,060 ft., $10,895; Boston, Chestnut streets, westerly 2,194 ft., $22,142; Centre, including part of Marion, 620 ft., $3,451; Rive & Ida, 700 ft., $4,541; Wheeler, 895 ft., $8,795; Broadway, Wyoma Sq. to Peabody line, 4,050 ft., $25,200; Eastern Ave., Essex to Western avenue, 5,071 ft., $31,552; Cottage, 2,133 ft., $11,561; Walnut, Kirtland to Wyman, 1,220 ft. $64,452; Myrtle, 2,640 ft. $8,418; Rogers Ave. 875 ft. $4,628; Stewart, 610 ft. $5,340; Maple, Western avenue to Chestnut St., 1,620 ft., $7,560; Chestnut—Olive to Lewis, 1,680 ft. $12,835; Atlantic, curbstones relaid. 928 ft., $4,332.

**Mass., Quincy**—A. Whiton, Mayor, has requested State Legislature to appropriate $150,000 to complete Furnace Brook Parkway.

**Mass., Worcester**—It was announced at meeting of Mass. Road Commrs., that government will expend $1,000,000 in this state for road work during 1910.

**Mich., Detroit**—Bids soon to be asked by Dept. Pub. Wks., for paving with asph. on 6-in. conc. foundation, Berea or Medina curbing, the following streets: St. Aubin Ave.—Newton to Euclid—28 ft. wide. Approx. cost $21,691; Medbury Ave.—Van Dkye to Fisher Aves.—26 ft. wide, at $28,210; Tuxedo Ave.—12th St., 26 & 20 ft. wide, $17,514; Begole Ave.—Beechwood to Tireman Aves., 26 ft. wide, $31,152; Medbury Ave.—Frontenac to Baldwin Aves.—26 ft. wide, $17,700; Iosco Ave., O. Mackinaw to Grand River Ave.—26 ft. wide, $12,013; Richton Ave.—Oakman to 12th—24 ft. wide, $8,336, and Philadelphia Ave., 26 ft. wide, $19,040; and many others.

**Mich., Lansing**—April 7th citizens will vote on $50,000,000 bond issue for constructing trunk line hwy. in state.

**Mich., Sault Ste. Marie**—Following paving items included in city budget for this year: Sect. of Carrie St., bitum. macad. est. cost $4,800; Algonquin Rd., bitum. macad., $8,000; Shallows Rd. $3,000; Dawson St., bitum. macad. $11,000; Oak street, brk. on conc. fdn., 750 ft. long and 25 ft. wide, $11,000; Ridge & Maple Sts., new top on pavements from Magazine to Johnstone St., $14,500 and $14,000, respectively; Arlington, brk. on conc., 750 ft. long and 36 ft. wide, $36,000; E. Spruce St., bitum. macad., $21,000.

**Miss., Meridian** — Lauderdale County, Beat 2, will build roads; $20,000 bonds voted and will secure $20,000 fed. aid.

**Minnesota**—Following work being considered for 1919: Clearwater, Mo., $40,000, H. K. Rude, Co. Aud., Bagley; Jackson Co., $50,000, P. B. McKellar, Co. Aud., Jackson; Meeker Co., $60,000, A. O. Palmquist, Co. Aud., Litchfield; Isanti Co. $40,000; F. A. Norell, Co. Aud., Cambridge; Lyon Co., $90,000, R. D. Houdersheldt, Co. Aud., Marshall; Pennington Co., $28,000, T. P. Anderson, Co. Aud., Thief River Falls, Minn.

**Minn., Minneapolis**—City will expend abt. $720,000 for paving during 1919.

**Minn., St. James**—Engr. Jno. W. Schaffer, 405 N. Y. Life Bldg., Minneapolis, preparing plans for 37,000 sq. yds. paving. Bids to be taken in April. Chris. Larsen, Clk.

**Minn., St. Paul**—Plans and specifs. being prepared by Commr. Goss for paving Como Ave.—Snelling Ave., past fair grounds to city limits, $60,000 appropriated in 1917 for the improvement by the legislature. Pavement will be of creosote blocks. Above named sum available as soon as city brings its share of the work to proper stage for payment of the money.

**Mo., Independence**—Jackson Co. Commrs. considering macadamizing 4½ miles dirt road from Holmes street to Red Bridge. O. C. Sheley, Co. Hwy. Engr., preparing estimates of ocst.

**Mo., Kans. City**—City has preliminary pendence Ave., 14,132 sq. yds., brk., $106,000 McGee St. Trafficway, 40,000 sq. yds. brk., $120,000; Rayton Rd., 28th St., to city limits, 25,988 sq. yds. bithu. or conc. paving; Bluff st. and several streets in Kansas City, Mo.—Robert W. Waddell, City Engr. has submitted preliminary report to Bd. Pub. Wks. on impvts. to be undertaken during 1919, at estimated cost of $2,630,000. Included are the following: 23rd street trafficway, $800,000; impvt. Union Sta. approaches, $130,000; paving Bluff St., and 4th street in West Bottoms, $200,000. Total expendt. authorized and proposed amounts to $6,623,000.

**Mo., Kans. City**—Jackson County will resurface 12 miles of Blue Ridge Road, 24 ft. wide. O. C. Sheley, Co. Engr.

**Mo., St. Joseph**—City has preliminary plans for street paving, to include: Frederick Ave., 18 blks.—brk. on conc. base, $3,277; Marion St.,—80 sq. yds. asph. conc., 840 linr. ft. conc. curb & gutter, 500 sq. ft. conc. drive, 400 sq. yds. brk. paving, etc.; also paving 6 alleys, 4,338 sq. yds. conc. paving. Est. cost $10,000. H. D. Judson, Engr., St. Joseph.

**Mont., Billings**—$62,000 will be expended for street paving and sewer construction during 1919. Money now available. City also contemplates paving in other sections of City to amt. of $36,000, which will be raised by tax levies or special assessments. Bond issue of $200,000 for street and sewer impvts. will be submitted in near future to be voted on by citizens.

**Mont., Deer Lodge**—County Commrs. plan to construct road outlet to Nevada and Big Blackfoot valleys; also considering constr. of road bet. Drummond and Helmville. Daniel B. Hartz, Jr., Co. Aud.

**Mont., Lewistown**—Delegation of Armells, Roy and Fergus citizens have called on County Commrs., to urge that road from Hilger north to Roy be immediately improved, especially the worst part of it—the Deer Creek hill. Matter will be taken up by the Board.

**Mont., Livingston**—Resolutions adopted by Park County Commrs., urging state legislature to memorialize congress in favor of appropriating a sufficient sum, not to exceed $1,500,000 with which to construct hard-surfaced road from Gardiner to New World mining district at Cooke City. Proposed road would cross portion of Yellowstone national park.

**Neb., Omaha**—One of the largest street grading operations ever undertaken will begin early this Summer, on the Dodge street hill. Dodge street will be graded from 17th to 22nd streets, with correspond-

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**CHICAGO, ILL.**

ing grading of lateral 18th, 19th and 20th streets to correspond with lowered grade of Dodge St. Cut will be as much as 22 ft. in depth at 19th and 20th streets. It will be steam shovel job. Total est. cost $100,000. Job will cut most of the 19th street hill; make 20th street nearly level from Davenport to Douglas streets and also cut down 18th street hill very much.

**N. J., Trenton**—Amended program for state hwy. constr. adopted by New Jersey state hwy. comn., calls for expendt. of $1,...0,851 for road bldg. in 1919. Work involves approx. 50 miles of road impvts.

**N. M., Gallup**—$60,000 will be expended for paving, work to start in April.

**N. M., Santa Fe**—Plans & specifs. for stretch of conc. road in Dona Ana Co., 11½ miles long, will be ready on Feb. 26th. Road is fed. aid project No. 15, and will probably be built during the Spring or Summer. Est. cost $172,000.

**N. Y., Binghamton**—County Supt. Van-Amburg announces that plans are ready for impvt. of the Hawleyton turnpike rd., at cost of $10,000, and that approx. $15,000 will be expended in reconstr. of hwy. from Oquaga Lake to McClure known as the Lake road. Other roads listed for consideration are the Whitney Point-Triangle, Binghamton-Vestal Center and Sandford-McClure highways.

**N. Y., Dunkirk**—City Engr. Shelton has been instructed to prepare plans and specfs. also estimates of cost for slagging the Roberts road leading into the city on the south; same instructions also issued in regard to imprvt. of Light street which leads from new pavement on Front street around Point Gratiot.

**N. Y., Syracuse**—City will expend $500,000 for street and sewer construction work. Curry C. Allen, City Engr.

**N. C., Charlotte**—City will pave sections of College, 2nd, 3rd, Poplar, & Brevard streets. Est. cost $85,000. A. H. Wearn, Commr.

**N. D., Carrington**—Co. Commrs. have designated 17 miles of roads for impvts. under state aid; 8 mi. east of Carrington between Sec. 20 & 21, in Rose Hill Twp. thru west side of Bordulacto Stutsman County line.

**N. D., Manden**—$200,000 to be expended for paving this year. H. L. Henke, Pres. City Comn.

**O., Canton**—County's Spring work will be started by Commrs. on Canton-Bolivar road and Ravenna-Louisville road; former to be paved with brick and the latter with bitum. macad.

**O., Cleveland**—County Commrs. have decided on improvement of road from No. Woodland road to No. Miles road—abt. 4.75 miles. Rd. will be constructed of brick, 16-ft. wide, at cost of $300,000.

**Ohio, Cleveland**—Paving work throughout City to start in April, also sewer construction. $634,853 now available; $900,000 will be raised by tax levies or assessments, and $2,967,000 will be raised for paving by bond sale. C. J. Neal, Director of Finance.

**O., Cleveland**—Co. Commrs. voted in favor of paving with brick Pleasant Valley Rd.—Middleburg Twp. line to state road—abt. 3½ miles. Est. cost $300,000.

**O., Cleveland**—Co. Commrs. have voted to improve Lee Rd., Cleveland Height from Miles avenue S. E., to so. line of East View—abt. 1.18 miles; also McCracken Rd. —Bedford to Lee, nine-tenths of a mile. Lee road strip will be paved with brick, at cost of $70,000; McCracken Rd., with waterbound macad., at cost of $31,000.

**Ore., Prineville**—Crooked River road now being surveyed. Construction may begin in about 90 days. State and Crook County have each appropriated $90,000 for the work.

**Pa., New Castle**—New Castle Bd. of Trade directors have requested Lawrence Co. Commrs. to bond county to the 2% limit for good roads construction. With state allowance and bond money, County should have about $1,500,000 for road work.

**S. C., Spartanburg**—Spartanburg Co. will construct 2 hard-surface roads leading from Spartanburg; one on Appalachian Hwy. toward Landrum and the other on Glenn Springs Rd. $142,000 available. J. A. Law, Chrmn.

**S. D., Brookings**—Louis P. Wolff, Engr., 1,000 Guardian Life Bldg., St. Paul, making plans for 96 blocks of paving and storm sewer to take care of paved district. Kind of paving not decided.

**S. D., Deadwood**—Lawrence County will probably construct 16 miles of Hot Springs hwy. this year. Est. cost $75,000. Fed. aid project. H. Johns, Co. Clk.

**Tennessee**—State Highway Commission will construct following highways: Nos. 1 & 10, Maury County, chert; $31,620; Flag Pond Road, Erwin, macad. $25,000; Hwy. No. 2, Greene Co., macadam, $38,322; No. 3 Carroll Co., chert, $120,000; No. 7, Marion Co., $25,000; No. 7, Coffee Co., chert, $38,533; No. 11, Henry Co., chert; $130,000; No. 1, Granger Co., macad. $60,000; No. 1 Hawkins Co., macad. $350,000.

**Tex., Austin**—State Hwy. Comn. contemplates extending State Hwy. No. 20 from Austin to Fredericksburg via Johnson City —80 miles macadam.

**Tex., Greenville**—Hunt County Commrs., (A. G. Gates, Judge) will vote abt. March 15th on $2,000,000 bonds to construct roads.

**Tex., Hunt County**—Will constr. 12.5 mi. rd.—Fannin Co. line south. Amount of wk. involved, $112,303.32. Date of opening bids not set. A. G. Gates, Co. Judge, J. H. Rush, Greenville, Engr.

**Tex., Houston, Harris County**—City and County will co-operate in paving Washington Avenue from intersection of Heights Boulevard to Camp Logan. Est. cost $64,000.

**Utah, Salt Lake City**—State Hwy. Comn., Salt Lake City, plans to build Fed. Aid projects during 1919 as follows: 9.25 mi. Ogden-Hooper Rd., $61,340; 63 mi. Price-Emery Rd., $409,923; 35 mi. Thompson-Moab Rd., $50,686; 24 mi. Moab-La Sal Jct. Rd., $34,755. I. R. Browning, Engr.

**Spokane, Wash.**—Constr. of hwy. down Spokane River Valley from this city to mouth of river, to connect with the roads of the upper Columbia valley into Fruitland-Hunter country, is proposed and meeting with favorable responses from the congressional delegation in Washington, D. C. It is proposed to build the road from funds secured thru the Indian appropriation bill.

**Wis., Yakima**—City Comn. passed resolution to pave S. Third Ave., and portion of Broadway Ave., its continuation to city limits, at est. cost of $46,000.

**Wis., Eau Claire**—Eau Claire Co. will expend betw. $80,000 and $100,000 on hwy. constr. this year. If plan prevails, 81 mi. trunk lines will be built. Eau Claire-Chippewa Rd., scheduled for last year, will probably be constructed.

**Wis., Superior**—Douglas County will advertise for bids in May for constr. work on various roads, to amt. of $85,000. W. J. Leader, Clk. Hwy. Comr., C. J. Mousette. Work calls for conc. culverts, graveling, excavating, etc.

**Wyo., Cheyenne** — State Hwy. Comn. plans to construct roads throughout state. If program submitted to Legislature is adopted, funds available for state hwy. constr. and maint. in 1919 will be $450,000, Fed. Govt. will appropriate $260,000 and counties $550,000. Z. E. Sevison, State Hwy. Engr.

## SEWERAGE AND SEWAGE TREATMENT.

**Ariz., Douglas**—Plans & specifs. being prepared for constr. of storm drain system for city. Trunk lines will be 4 to 5 ft. in diam., & will be constructed of reinf. conc. and cement with vitr. clay pipe. Total est. cost $100,000. Olmstead & Gillelen, Hollingsworth Bldg., Los Angeles, Engrs.

**Cal., Chino**—City Council has voted for an enlargement of sewer system by an additional 1,650 ft. Work will be started at earliest possible opportunity. Plans and specifications accepted by Council.

**Cal., Redwood City**—City considering improving sewage system, including the constr. of an outfall sewer, sewage pumping plant and macad. rd. to pumping station, involving 3,400 lin. ft. vitr. pipe. Total est. cost $35,000. C. E. Dimick, City Engr.

**Cal., San Francisco**—City considering expendt. of $1,500,000, to be raised through tax levies or special assessments, for sewer and street impvts.

**Colo., Denver**—Work on sewer and street impvts. will begin early in Spring. Est. cost $216,000 which is now available for the work. Frank M. Ladd, Chf. Bldg. Inspector.

**Conn., New Haven**—City plans to sell $100,000 bonds for constr. of sewerage system in Westville district, F. L. Lord, City Engr.

**Conn., Waterbury**—Constr. of proposed Watertown avenue sewer extension from Robbins street to Bunker Hill road approved by Bd. of Public Works. Est. cost $14,5000.

**Del., Wilmington**—Abt. April 1st work will start on sewer and street improvements. $75,000 available for work. Jno. W. Lawson, Mayor.

**Ill., Chicago**—Trustees of Sanitary Distr. passed over veto of Pres. Chas. H. Sergel, appropriations of $950,000 for an intercepting sewer and sludge plant for treatment of waste and sewage of stock yards district.

**Ind., Gary**—Gary, Hammond, E. Chicago & Whiting, Lake County, will request permission of Indiana legislature to organize drainage district for purpose of making disposition of sewage of Calumet region. According to plan each city would control its own sewer system, but central plant would be established & maintained for the dilution or other treat. of sewage before it was emptied into Grand Calumet river.

**Ind., Indianapolis**—Bd. of Sanitary Commissioners preparing to proceed with wk. of plans for constr. of sewage disp. plant. Est. cost $2,000,000. Work will probably be started in Spring. Final wk. to be undertaken will be constr. of a huge interceptor to carry city sewage from main sewer to sewage disp. plant.

**Ind., Mich. City**—City will construct trunk sewers this year to cost $250,000. Funds will be raised by tax levies or assessments. Fred C. Miller, Mayor.

**Ind., Princeton**—City considering constr. of sewer system in North Side district, $45,000. H. E. Morrison, City Engr.

**Ind., Terre Haute**—City considering constr. of sewers in various sts., involving 1 mile 12-36 in. conc., vitr. or segmental blk., pipe, etc., at abt. $30,000. R. A. Koerner, City Engr.

**Ia., Cedar Rapids**—City considering constr. of storm sewers on various sts. R. F. McCanley, Engr. $190,000.

**Ia., Davenport**—City considering construction of 400 ft. 6-in. storm drain sewer and 1,300 ft. tunnel in the Blackhawk Creek Dist. Total est. cost $100,120. R. E. Sawistowsky, City Engr.

**Ia., Ft. Madison**—If plans of present members of City Council are carried out, sanitary sewer system will be built within a very short time. Burns & McDonnell, Engrs., Kansas City, Mo., have submitted revised estimate for the work—$219,705.25.

**Ia., Iowa City**—Plans under way for trunk line sanitary sewer. Bids will probably be taken in Spring. Est. cost $20,000. C. Day, Engr.

**Me., Auburn**—City considering gravity sewerage system. Engr. H. K. Barrows, 6 Beacon street, Boston.

**Me., Bath**—U. S. Housing Corporation will construct sewer from so-called Palmer field to Me. Cent. track west of L. A. W. St. Ry. car barn on No. street—abt. 4,000 ft. There it will join main trunk sewer extending to Kings Dock. Weston & Sampson, Engrs., Boston, have been instructed to draw up specifications covering constr. of sewer. Geo. T. Prince, Distr. Engr.

**Md., Baltimore**—Plans drawn for sewage disp. plant. $80,000. Engr. L. L. Houston, Jr., Fredericksburg, Md., and 602 Parkwyrth Ave., Baltimore.

**Md., Towson**—Baltimore County Commrs. will construct sewage-disposal system to cost $100,000. Hugh H. Gallagher, Clerk, Courthouse.

**Mass., Boston**—City considering sewer and street impvts. amounting to $1,450,000; work to start during period betw. April 1st & Dec. 15th, 1919. Funds will be raised by tax levies or special assessments.

**Mass., Brockton**—Alderman Hunter presented order for appropriation of $25,000 for extension of sewerage constr., as unanimously passed under suspension of rules.

**Mass., Lynn**—City contemplates expendt. of $126,228 for construction of sewers in various sections.

**Mass., Millis**—Plans drawn for sewerage system—abt. 5 mi. $75,000. Engr. Erastis Worthington, Ins. Bldg., Dedham, Mass.

**Mass., Worcester**—Bill being drawn, which will soon be filed with Mass. legislature, authorizing City to borrow outside of its debt limit, the sum of $1,000,000 in such amts. and at such times as Council may by vote direct, to be used for the enlargement and improvement of sewerage purification works. City Solicitor Jno. W. Mawbey, preparing bill.

**Mich., Detroit**—Commr. Esselstyn, announces that he will immediately start work on 1918 sewer program interrupted by the war, and will in very near future ask bids on contracts totaling $7,000,000, the amt. held back for this work.

**Mich., Port Huron**—Survey being made for conc. road running 10 mi. south. If the $50,000,000 road bond issue carries, road will be constructed by the state—otherwise under the Covert act.

**Mo., Kansas City**—Robt. W. Waddell, City Engr. submitted to Bd. Public Wks. preliminary report on impvts. to be undertaken during 1919, including $1,100,000 for Turkey Creek sewer and $400,000 for district and joint sewers; projects proposed, but upon which final action has not been taken, include $2,500,000 for Blue River sewer.

**N. Y., Schenectady**—Bd. of Est. & Apportionment approved plans for proposed storm sewer bond issue and the $60,000 will be forthcoming when needed.

**O., Akron**—Resolution passed to issue and sell bonds in sum of $3,000,000 for constr. of trunk sewers on N. Hill, E. Akron, S. Akron and W. Hill and other districts in city. E. N. Seiler, Clk.

**Ohio, Cleveland**—City will expend $635,835 for sewer and street impvts.; work to start in April. Money now available. Also contemplates other sewer and street impvts., amounting to 900,000, to be paid for from tax levies or special assessments. C. J. Neal, Director of Finance.

**Pa., New Kensington**—Ord. passed authorizing issuance of $25,000 bonds for sewer, street and bridge work.

**Pa., Scranton**—City contemplates sewer and street impvts., amounting to $232,738. Alex. T. Conned, Mayor.

**Pa., Woodlawn**—Boro has had plans drawn for sewage disp. plant. Est. cost $50,000. Boro Engr., W. M. Anderson, Woodlawn.

**S. D., Aberdeen**—Election will be held in April to vote on $250,000 bonds for sewer and street impvts. Work will start after bond sale.

**Va., Petersburg**—City considering additional bond issue of $200,000 to complete sewer and water systems.

**Wash., Seattle**—City contemplates expendt. of $1,000,000 for sewer constr. Money will be raised from tax levies or special assessments. Work contingent on consent of citizens.

**Wis., Milwaukee**—Construction of Rush Avenue sewer will begin in very near future; will be 3,340 ft. long and 84 inches in diam., and will cost abt. $90,000. Abt. $80,000 will be expended on Dakota street sewer-tunnel which is to be 1,522 ft. long & 70 inches in diameter. Linwood avenue tunnel will be 7,720 ft. long and 9 ft. in diam. and will cost abt. $500,000.

**W. Va., Wheeling**—City will expend $100,000 for sewer and street impvts.; work to start in July. City also contemplates similar work amounting to $100,000 (funds to be raised through bond sale) and $250,000 (to be supplied by tax levies or assessments). Address City Mgr.

## WATER SUPPLY AND PURIFICATION.

**Ariz., Prescott**—H. Phillips, International Life Bldg., St. Louis, Mo., Consulting Engr. for Prescott in preparing of plans for reconstructing water distribution system, to include bldg. new water system, storage reservoir, canal, headgate and supply pipe line. Est. cost abt. $300,000.

**Ark., Fort Smith**—City contemplates water works improvements to include weir in Poteau River and reservoir on Crowe Hill.

**Cal., San Francisco**—City contemplates expending $17,000,000 for water and power plants; money to be raised through sale of bonds.

**Colo., Denver**—City will expend $610,000 for water extension; work to begin in early spring. Frank M. Ladd, Chf. Bldg. Inspector.

**Conn., New Britain**—City having plans drawn for water works, $1,000,000. Work includes raising present dam. bldg. tunnel through rock, bldg. canal and water tower. Legislature will be asked for permission to issue bonds.

**Conn., Waterbury** — City contemplates construction of new storage reservoir and new pipe line; bonds may be issued in sum of $3,000,000 to pay cost of constr. Legislative premission to issue and sell the bonds being asked. Council plans to have work start early this summer.

**Cal., Sacramento**—Citizens will vote April 30 on bond issue of $1,200,000 for constructing water filtration plant. J. C. Miller, City Engr.

**Cal., Santa Rosa**—Permanent water supply for Sonoma State Home at Eldridge, Sonoma Valley, practically assured. Senator Slater has introduced bill at Sacramento asking appropriation of $90,000 for work and bill has endorsement of State Board of Control, as water supply is absolute necessity for the institution.

**Ill., East Alton**—Bids soon to be received by T. L. Van Pretre, Pres. Bd. of Local Impvts., for constructing new water works system, involving 3,600 ft. 8-in., 13,700 ft. 6-in., 8,840 ft. 4-in., and 13,020 ft. 2-in. cast iron pipe, valves and hydrants. Est. cost $64,000. Sheppard & Morgan, Engrs., Edwardsville, Ill.

**Md., Cumberland**—City contemplates installing 3 miles water pipe, also sewer constr. and paving. Bonds $200,000. M. R. Hart, City Clk.

**Md., Princess Anne**—Plans drawn for water distribution system. $60,000. Engr. J. L. Houston, Fredericksburg, Va. and 302 Parkworth Ave., Baltimore.

**Mass., Danvers**—Town has applied to State Legislature for authority to borrow $200,000 to rebuild and relay watermains, improve storage, pumping and distributing facilities.

**Mass., Fitchburg**—City applied to State Legis. to borrow 300,000 for purpose of extending present water works system. F. H. Foss, Mayor.

**Mo., Kansas City**—Board has accepted recommendation of W. G. Goodwin, Supt. Water Dept. to purchase 8½ acres at 75th and Holmes Sts., as site for another reservoir of 10,000,000 to 12,000,000 gals. capy.

**Minn., St. Paul**—City will probably build stand pipe, Dale Street, to increase water pressure. Est. cost $10,000. H. W. Austin, City Purch. Agt. City will also take bids for water main from Cayuga and Mississippi Sts., to Broadway and Grove streets, 30-in. dam. $65,000.

**N. Y., Syracuse**—City will expend $250,000 for impvts. to water works, supply lines, power plants, etc., during 1919. Curry C. Allen, Engr.

**Okla., Guthrie**—$250,000 available for water works impvts. Work will begin in February or March. City also considering waterworks extension. $250,000 bonds sold for this work. J. W. Mortman, Mayor.

**Okla., Henrietta**—Plans being prepared by Burns & McDonnell, Engrs., 400 Interstate Bldg., Kans. City, Mo., to improve water works. Est. cost $250,000. H. M. La Rue. Supt. Water Wks.

**Okla., Altus**—Plans & Specifs. prepared & on file with City Clk. for water works extensions. Date for receiving bids not set until right-of-way for proposed impvts. is secured. Wk. includes constr. of storage reservoir, main & by-pass dams, with 6 miles of earth canal. Est. cost $100,000. Benham Engrg. Co., Consit. Engrs. 13th Fl., Colcord Bldg., Okla. City.

**Okla., Muskogee**—Chamber of Com. has adopted report of Water Works Comn., recommending submission to voters of bond issue in sum of $130,000 for impvts. to water works system, including the laying of a 20-in. main through heart of city.

**Okla., Pawhuska**—City plans to vote on $200,000 to $300,000 bonds to establish water system.

**O., Cleveland**—City considering impvts. to water works, water supply lines, power plants, etc., amounting to $500,000; funds to be raised through bond sale. Work may begin in April. C. J. Neal, Director of Finance.

**Ohio, Elyria**—Unanimous & enthusiastic approval given Council's plans for enlargement and impvt. of city water works, at meeting of citizens & officials. Council will start legislation at once for issue of $350,000 in bonds which will represent abt. one-half of total cost of project.

**O., Youngstown**—City contemplates issuing bonds in sum of $165,000 for constructing water line from point near old pumping station to Albert St., and Oak street. M. F. Hyland, Clk.

**Utah, Price**—City contemplates expendt. of $200,000 for water works impvts. Money will be raised through bond sale.

**Utah, Salt Lake City**—City considering impvts. to water works, supply lines, power plants, etc. Funds will be raised through bond sale—$1,000,000.

**Va., Fredericksburg**—City will construct waterworks, including mains, dosing apparatus, etc., capy. (daily) 1,000,000 gals. L. J. Houston, City Mgr. Date of opening bids not set.

**Wis., Milwaukee**—City plans to drill artesian wells in various sections of city. $50,000 approp. for project. G. Staal, City Engr. Village of Shorewood also contemplates water mains and sewers. F. W. Ullius, 1305 Cramer St., Milwaukee, Village Engr.

**Wash., Seattle**—City may expend $4,000,000 for water wks. impvts.; funds to be raised through bond sale. May also construct water mains amounting to $500,000, if citizens give consent.

## BRIDGES AND BUILDINGS.

**Conn., New Haven**—Plans being prepared for constr. of a 300-ft. bridge, 25-30 ft. wide, at Belle Dock on Forbes Ave., replacing the old Tomlinson brdge. Est. cost, $500,000. F. L. Ford, city engr.

**Ill., Chicago** — City has $14,718,000 in bonds awaiting expenditure. Following list of impvts are those on which contracts have either been awarded or are ready for advertising (bonds approved for this work): Kimball Ave., bridge, $75,000; La Salle street bridge, $550,000; Madison street bridge, $850,000; Addison street brdg., $175,000; South Lawndale avenue brdg., $50,000; So. California avenue brdg., $30,000. There is also $260,000 for incinerators, loading stations, etc., etc., on Goose Island. Fed. Govt. has forbidden constr. of LaSalle street bridg. until one on Wells street is completed; this bridge abt. 20% finished; it is also reported work on Madison street bridge cannot begin until Monroe street brdg. is finished. Latter brdg. nearing completion.

**Ind., Columbus** — Bartholomew County Council has appropriated $70,000 for bldg. new bridges; $50,000 of this sum to be used for bridge across Driftwood river in tihs city.

**Ind., Richmond**—Richmond will construct new concrete bridge to cost abt. $200,000 to connect So. Richmond and West Richmond.

**Me., Portland**—Rep. Allan of this city, introduced an act in House at Augusta, to provide for reconstr. of bridge betw. Portland and So. Portland. Act provides that County Commrs., Cumberland Co., are authorized to repair or reconstruct such portions of Portland bridge as may be necessary, and to borrow $50,000 for purpose of paying necessary expenses in connection with this bridge, the county from time to time to issue bonds, aggregate amt. of which shall be $250,000.

**R. I., Pawtucket** — Plans prepared for constr. of 3-span conc. arch brdg., 180 ft. long and 60 ft. wide over Blackstone River at Exchange St. Est. cost, $100,000. Haven & Doty, Archts., 220 Devonshire St., Boston, Mass.

**S. C., Columbia**—No. Car. General Assembly has granted permission to Mecklenberg Co., N. C., to co-operate with York County in erection of a steel bridge across Catawba River at Wright's Ferry. Demand for constr. of this bridge is strong throughout Bethel Twp. and Northern York Co.

**Utah, Salt Lake City**—City contemplates constr. of 3 bridges over Jordan River and Surplus Canal. Est. cost, $40,000. S. Cannon, City Engr.

**Wash., Seattle**—$175,000 available for constr. of trestle and $60,000 for bridge approach. Work on trestle brdg. will begin in May.

**Wis., Racine**—City Engineer, P. H. Connelly, City Hall, has completed plans for bridge improvement and alterations; work to start after March 1st. 1,220 cu. yds. conc., brick paving, cement walks.

## DRAINAGE AND IRRIGATION.

**Cal., Dinuba**—Plans being made by Elmer Sibley, Supt. Alta. Irrig. Dist., for bldg. abt. 106,000 sq. ft. cement lining in district's ditches, replacing drops with cement structures, and replacing abt. 900 ft. wooden flume with cem. pipe this year. Abt. $30,000.

**Ia., Iowa City**—Petition to be presented to Bd. of Supvrs., Johnson Co. for widening and straightening Old Man's Creek; stm. shovel work; several miles long. Edw. Sulek, Aud., Iowa City.

**Ia., Montezuma**—Plans in progress for Bear Creek Ditch (Poweshiek Co.) ditch; main ditch 11.72 mi. long; 330,000 yds. excav., 3 laterals. 2.3 mi. long, 65,000 yds. excav. ready for bids abt. April 1st. T. L. Blank, Engr., Oskaloosa. W. C. McKee, Aud.

**Minn., Pine City**—Petition for Ditch No. 8, Pine County, granted. Near Anov, Minn. Est. cost, $33,000. Andrew P. Edin, Co. Aud.

**Mo., Hardin**—Bids will be received abt. May 1st by Wm. Esslinger, Hardin, for draing. wk. in Ray Draing. Dist., involv'ng. ditches from 4 to 25 ft., one to one slopes and 4 to 18 ft. deep; also levees 3 ft., 3 to 1 slope, involv'g. 860,000 cu. yds. excav., and 565,000 cu. yds. levee. Total est. cost, $300,000. Clarke E. Jacoby Engr. Co., Kansas City, Mo. Engrs.

**Mo., Richmond** — Kenney Crk. Draing. Dist. has plans by C. E. Jacoby Engrg. Co., Shubert Bldg., Kans. City, Mo., for draing. canal and levees, Ray Co., $150,000; constr. by floating dredge or drag line.

**N. C., New Holland** — Mattamuskeet Drainage Dist., is prepared to let contract for suction dredge work, 1,500,000 cu. yds.

**Tex., Brownwood**—E. D. Balcom, Engr. Dallas, will make surveys of bayou valley with view to impounding storm waters on watershed north of here to secure water supply for irrigation purposes.

**Wis., Racine**—Racine County, Hoods Crk. Draining Dist., project being revived. Constr. probably will start in spring; 15 mi. tile and open ditch, town of Pleasant. P. J. Myers, Atty. 1st Natl. Bank Bldg., Racine.

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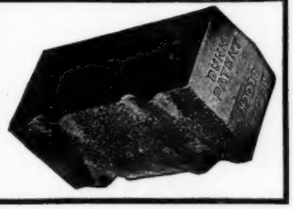

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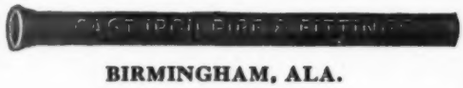

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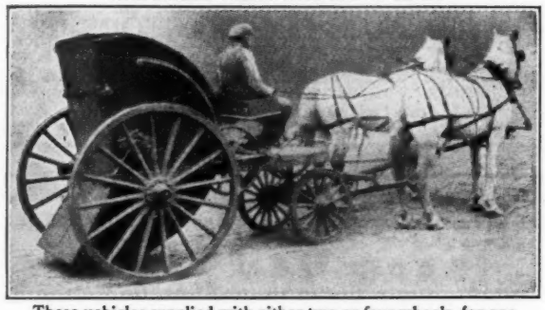

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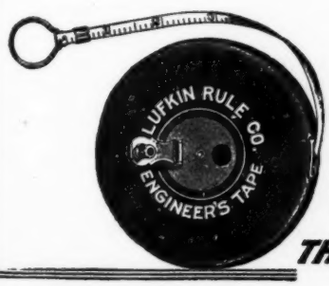


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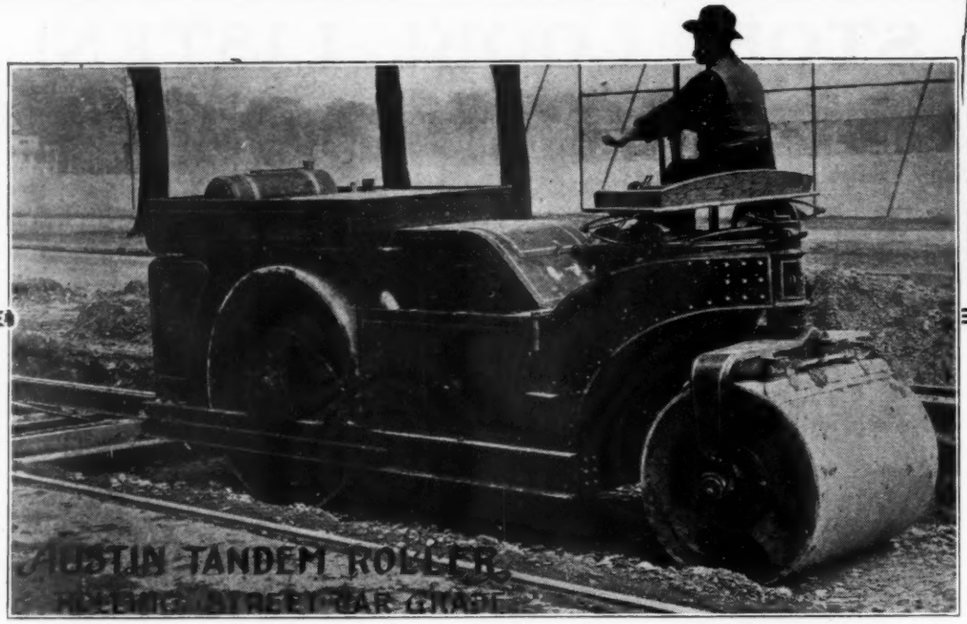


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